Volume 1 Aardvark to Army

The GOLDEN BOOK ENCYCLOPEDIA

REVISED EDITION

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STATE INSTITUTE OF EDUCATION
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The GOLDEN BOOK ENCYCLOPEDIA

NEW REVISED EDITION

VOLUME 1—AARDVARK TO ARMY

STATE INSTITUTE OF EDUCATION
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IN SIXTEEN ACCURATE, FACT-FILLED VOLUMES
DRAMATICALLY ILLUSTRATED WITH MORE
THAN 6,000 COLOR PICTURES

* * *

ESPECIALLY DESIGNED FOR
YOUNG GRADE-SCHOOL CHILDREN
ACCURATE AND AUTHORITATIVE
ENTERTAININGLY WRITTEN AND ILLUSTRATED
TO MAKE LEARNING AN ADVENTURE

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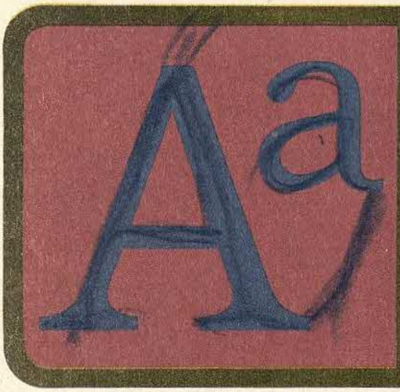
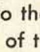


The letter A began as the picture of the head of an ox, . The makers of the first alphabet borrowed the picture from the Egyptian writing called hieroglyphic.

As a letter, the picture was not always drawn in the same way. In time it did not look like an ox's head at all, . The Greeks, when the alphabet came to them, changed the letter so that it was much like the capital A of today, .

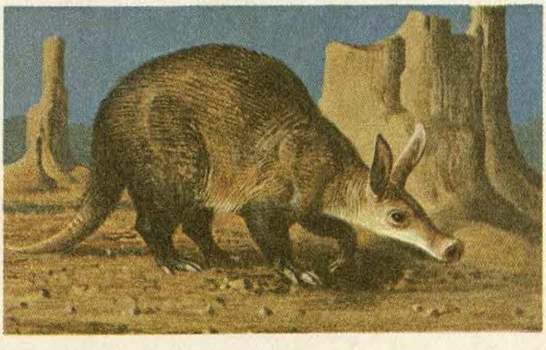
A has several sounds. It has a different sound in each of these words: *call, cat, clay, car, care,* and *sofa.*

Three letters are whole English words. A is one of them.

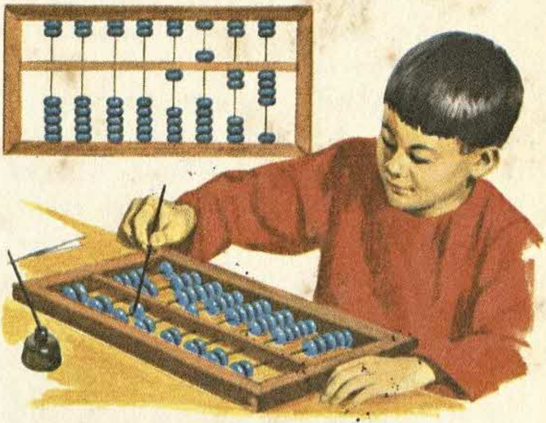
AARDVARK (ARD vark) The aardvark is an African animal. Its queer name is made from two Dutch words meaning "earth" and "pig." In some ways "earth pig" is a good name for this animal. An aardvark spends its days curled up in a hole in the ground, and its body is shaped much like a pig's. But it does not stay in the ground at night, and in many ways, as the picture shows, it does not look like a pig.

Aardvarks live chiefly on termites. An aardvark can rip open a termite nest easily with its strong claws. It can lick up the termites fast with its long, sticky tongue. It may eat a hundred thousand at one meal. Aardvarks also eat ants.

African natives kill aardvarks to eat. But these "earth pigs" are not easy to catch. Although they look clumsy, they can run fast. They can bury themselves in the ground fast, too. But they do not always run or hide when they are in danger. An aardvark may stand up on its hind legs like a kangaroo and fight.



ABACUS (AB a kus) The Chinese boy in the picture is counting with an abacus. His abacus has wooden beads that can be moved up and down on wires. On the wire farthest to the right, each bead below the crosspiece stands for 1. Each bead above it stands for 5. On the second wire each bead below the crosspiece stands for 10, and each bead above it for 50. On the third wire the beads stand for hundreds, on the fourth for thousands, and so on. As the boy uses a bead in counting, he moves it toward the crosspiece. On his abacus the beads now say 1,524.



An abacus can be used to add, subtract, multiply, and divide as well as count. A skilled person can solve problems fast.

Abacuses have been used for several thousand years. In the Western world they are seldom seen today. But they are still a very important means of calculating in Russia, the Near East, and the Orient.

ABBREVIATIONS Many of our thermometers are marked with the Fahrenheit scale. "Fahrenheit" is a long word. Very often, to save space, a shortened form—F.—is used instead. Such a shortened form is called an abbreviation.

Some abbreviations are used so often that many people do not remember what the longer forms they stand for are. "FBI," for instance, is a much-used abbreviation. Many who use it do not know that it stands for "Federal Bureau of Investigation."

A list of all the abbreviations in everyday use would take several pages. Among the very common ones are those for states. "Conn." is much easier to write than "Connecticut," and "Mass." is much simpler than "Massachusetts." Now the United States Post Office permits still simpler abbreviations of state names if the ZIP code is also given. These are the simpler abbreviations for a few of the 50 state names.

Alaska	AK	Connecticut	CT	Oklahoma	OK
Arizona	AZ	Hawaii	HI	Texas	TX

Acronyms are short names made by using just the initials of several-word names. "WAC" (*W*oman's *A*rmy *C*orps), "NASA" (*N*ational *A*eronautics and *S*pace *A*dministration), "scuba" (*s*elf-*c*ontained *u*nderwater *b*reathing *a*pparatus), and "laser" (*l*ight *a*mplification by *s*timulated *e*mission of *r*adiation) are examples of acronyms.

ACCORDION An accordion is a musical instrument. It is called a solo instrument because it is not often played with other instruments.

A person who is trying to tell what an accordion is like usually moves his hands in and out. For pushing the ends of an accordion together and pulling them apart are important in playing this instrument.

The folding part of an accordion is a bellows. Pulling the ends apart draws air in. Pushing forces it out. The sound is made by strips of metal called reeds. The moving air makes these strips move back and forth, or vibrate. Different reeds make different sounds when they vibrate. The reeds are fastened to the keys on the keyboard of the accordion. By pressing the right keys as he pushes and pulls, the player can play tunes.

A concertina is a simple accordion. Concertinas used to be very popular with sailors, who played sea songs on them during their long ocean voyages.

ACHILLES (a KILL eez) The Greek warrior Achilles is one of the heroes of Homer's famous *Iliad*. The *Iliad* is a long poem telling the story of the Trojan War and of the Greeks and Trojans who fought against one another in it.

Achilles was the son of Thetis, a sea-goddess. When he was only a baby, the gods of the sea told his mother how she could make her son invulnerable. "Invulnerable" means "cannot be wounded." She was to plunge him beneath the waters of the river Styx. She did so, holding him by one heel.

In the Trojan War Achilles fought battle after battle without being harmed. In one battle he killed Hector, the son of the king of Troy. With his chariot he then dragged Hector's body around and around the walls of Troy. But in the end Achilles was killed by an arrow shot into the heel that had not been touched by the water of the Styx.

The name of the cord, or tendon, at the back of each of our heels reminds us of this story of long ago. It is called the Achilles tendon. (See TROJAN WAR.)

ACIDS AND BASES Lemons are sour because they have an acid in them. There are many different acids, and they are all sour. Vinegar is an acid. Grapefruit and apples and cherries have acids in them. So do many other fruits. Sour milk is sour because an acid has formed in it. An acid in our stomachs helps us digest our food.

The acids in the food we eat—the citric acid of lemons, for example—are all weak. Their sour taste is pleasant. But acids may be so strong that they are not safe to handle. Strong acids can eat through a person's skin and cause sores. They can eat holes in cloth. They can even dissolve metals.

Strong acids are used in manufacturing many different kinds of things. Fertilizers, paints, and explosives are a few of them. Sulfuric acid, hydrochloric acid, and nitric acid are three of the strong acids.

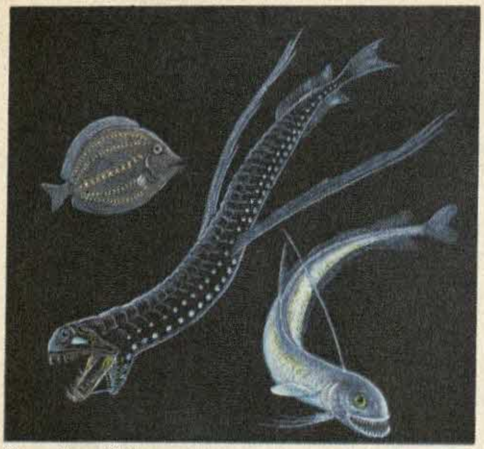
The acid in our stomachs is hydrochloric acid. But it is weakened with water.

There are many ways of finding out whether a substance has acid in it. One way is to use paper that has been colored with a dye called litmus. Acids turn blue litmus paper pink.

Acids make up one group of chemicals. Another group of chemicals are called bases. Bases turn pink litmus paper blue. Limewater, ammonia, and lye are common bases. Some bases are very strong. Lye is one. Like strong acids, strong bases must be handled carefully. Bases are sometimes called alkalies. They are used in making many things, soap among them.

Acids and bases are often called opposite chemicals. An acid can be used to keep a base from doing harm, and the other way around. When an acid and a base are put together, a different kind of chemical is formed. It is called a salt.

Hector and Achilles



Deep-Sea Fishes

A mole's broad feet are good for burrowing.

A chameleon's long tongue catches insects.

ADAPTATION TO ENVIRONMENT

Once a count, so a nonsense jingle says, went out to hunt for starfish in a forest. He wanted to make himself famous by bringing down a starfish from a tree.

No one finds starfish in forests, because starfish cannot live there. A starfish could not breathe or move about on the branch of a tree. There would be no food for it to eat. It is fitted for living along the seashore instead. In its body it has water-filled canals that are connected with tube feet. These tube feet help the starfish move and breathe and catch other animals to eat. A starfish in a forest would be as much out of place as a whale in a pasture or a monkey in the middle of the sea.

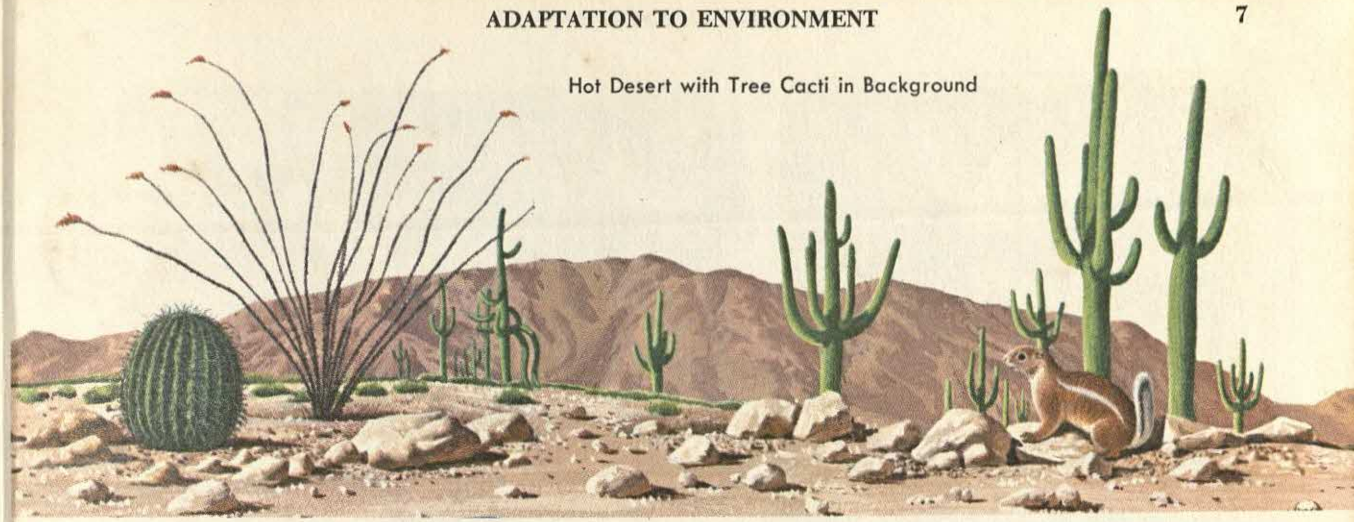
In all the world there are hundreds of different kinds of places in which living things are found. One place may differ

A hummingbird's long bill is good for sipping nectar.

Walkingsticks look like twigs.

Common Starfish

A pangolin's claws and tongue help it get termites to eat.



Hot Desert with Tree Cacti in Background

Kangaroo Rat

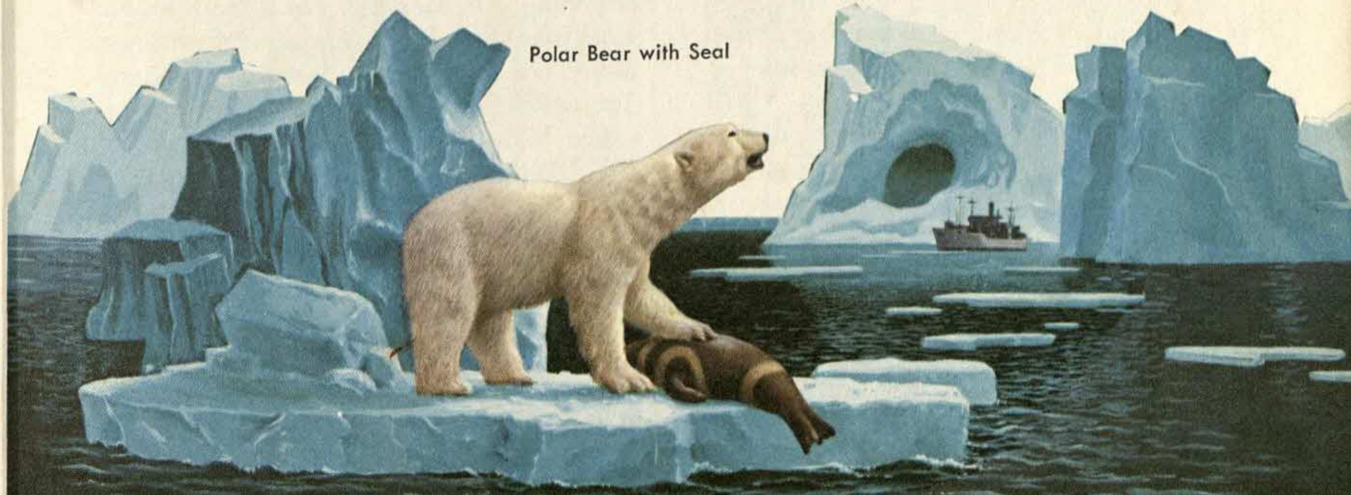
from another in a great many ways. In almost every kind of place we find some living things that are specially fitted for living there. They are, we say, adapted to their environment.

The polar bear is fitted for living where there is ice and snow the year round. Its coat of fur is thick and oily. The fur shuts in the warmth of the bear's body. It keeps the cold water away from the bear's skin when the bear goes into the sea to find food. There is fur even on the soles of the bear's feet. It keeps the animal from slipping on the ice. The polar bear can more easily catch the animals it hunts because its color matches the snow and ice round about. Many animals match their surroundings.

The kangaroo rat and the saguaro, or tree cactus, are both fitted for living in hot deserts. The rat does not have to have any water to drink. It gets the water it needs from the food it eats. The saguaro has stems that serve as water tanks. Since it has no leaves, the water it takes in does not evaporate fast.

Deep-sea fishes like those pictured are strange-looking creatures. And they differ from most fishes in an important way. The pressure inside their bodies is so great that they can stand the terrific pressure of the water deep below the surface.

The captions of their pictures point out some of the ways in which the mole, hummingbird, pangolin, chameleon, and walkingstick are fitted for living where they do. Of course, only a few of the more than a million kinds of living things are shown here. The encyclopedia pictures hundreds of others. As you look at them you will be able to see for yourself many good examples of adaptation to environment.



Polar Bear with Seal

ADVERTISING Every day we see and hear a great deal of advertising. The words and pictures on our box of breakfast cereal are advertising. Our carton of milk usually has advertising on it. The commercial we hear on radio and both see and hear on television is also advertising. So are most of the circulars our mailman brings.

Newspapers are full of advertising. Some advertisements are tiny want ads. Others fill several pages. Sometimes what seems to be a comic strip may turn out to be advertising. Magazines, too, carry advertisements. As we walk along the street, we see displays in store windows and pictures on billboards. At night huge electric signs flash in many colors. All of these are advertising. So is skywriting.

Different as they are, all these advertisements are alike in one important way. They have the same purpose: to get people to buy some product or some service.

In the days of the cavemen there was no advertising. There was no need for it. But as soon as people began to make things to sell, advertising was found to be useful. The merchants of ancient Egypt hired criers to walk through the streets shouting or singing about the things they had to sell. Newsboys still sometimes "cry" their papers, and street vendors their wares.

In the Middle Ages merchants hung picture signboards over their shop doors showing what they had to sell. A large picture of a shoe above a shop door meant that this was a shoemaker's shop. It suggested buying shoes or having old ones mended.

As more things were made to be sold and more people had services to sell, advertising grew. Today it is one of our biggest businesses. Every year billions of dollars are spent on advertising.

Advertising helps sell more things to more people. This in turn makes it possible to produce more things to sell. Sometimes it even helps make things cost less. In the beginning, for example, radios cost much more than they do today because they were turned out slowly and expensively by hand. But advertising made more people want radios. When manufacturers began making them by the thousands, they found quicker and cheaper ways of doing the job. Because advertising starts us to buying and producing more things, it is sometimes called the spark plug of the business world.

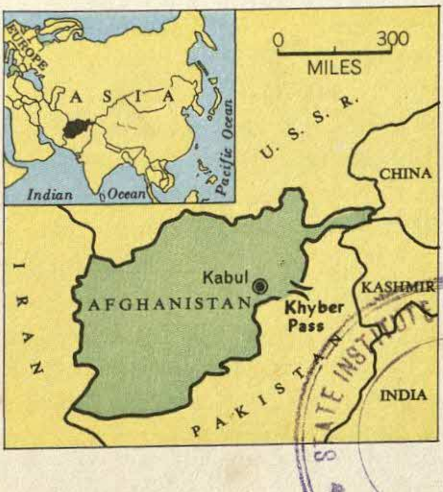
AESOP Some stories we know and like are many hundreds of years old. Among them are Aesop's fables. Aesop is supposed to have lived in Greece about 600 B.C.

Nothing is known surely about his life. Some say he was once a slave. Others believe that no such person as Aesop ever really lived—that different people, some of whom lived long before 600 B.C., made up the stories.

Fables are stories meant to teach a lesson. Most of Aesop's fables are about animals that can talk. Two of the best known are "The Hare and the Tortoise" and "The Fox and the Grapes."

Aesop did not write out his stories. Instead, he told them aloud, and later storytellers handed them down from generation to generation. The stories as we know them were put in writing centuries after Aesop's time. (See FABLES.)

AFGHANISTAN Most of the countries of Asia have a seacoast. Afghanistan is one that does not. This inland country is sometimes called a land of "rocks, stones, and bloody feuds." It is mountainous, and some of its people are fierce fighters. Afghanistan separates the U.S.S.R. and Iran from Pakistan, once a part of India. Khyber Pass, one of the most famous mountain passes in the world, leads from Afghanistan down to the plains of Pakistan. It served as a gateway to India for thousands of years.



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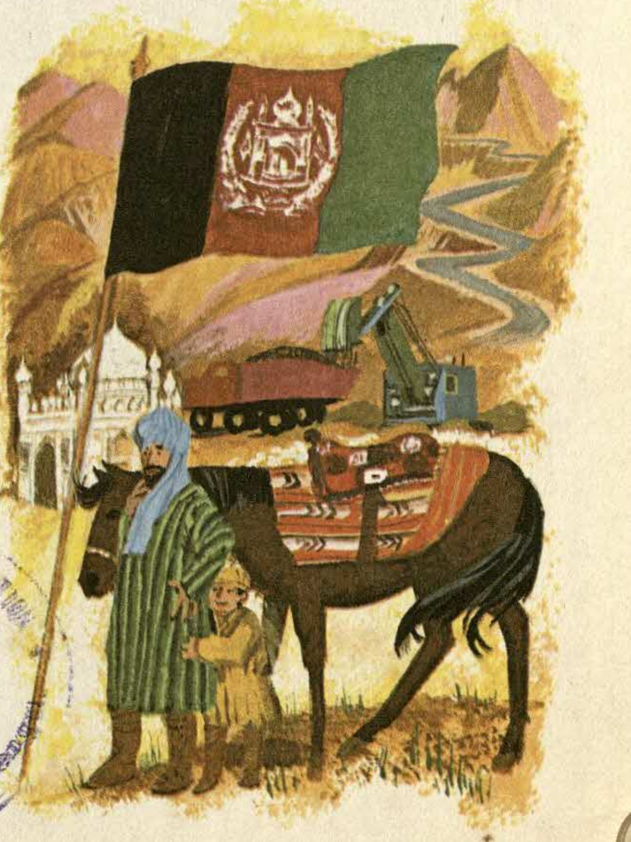
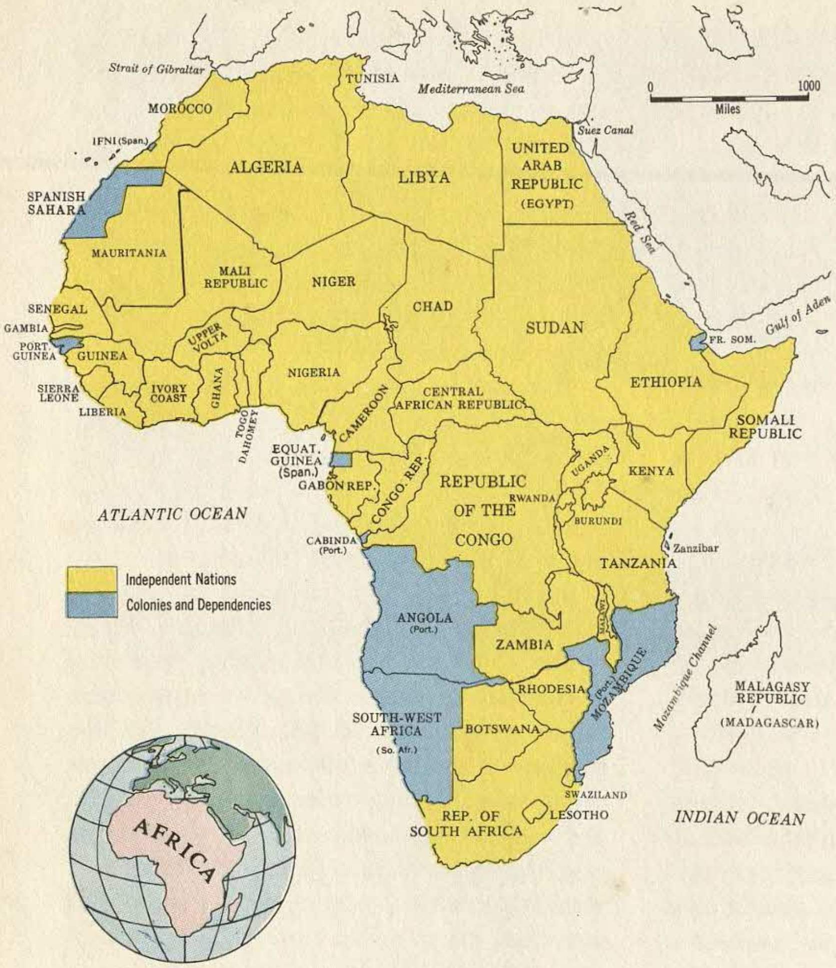
Most of the people of Afghanistan are farmers or herdsmen. Some of the herdsmen are nomads. Much of the land is too dry and rocky to be farmed. But on the good land the farmers raise many kinds of fruits, vegetables, and nuts as well as cotton and grain. The herdsmen have big flocks of fat-tailed sheep. The sheep furnish skins, wool, and meat. Their tails furnish fat which is used instead of butter.

The country has stores of minerals—iron, gold, coal, lapis lazuli, and ruby among them. But as yet not much mining is done. The few factories turn out such products as leather goods, furniture, and cement. There are some electric power plants.

In all Afghanistan there is not a single railroad, but there is a plan for one. Many of the country's roads are being improved so that trucks, buses, and cars can use them more easily. Kabul and Kandahar, the two biggest cities, have airports. Several other cities have landing strips. Ponies, donkeys, and camels, however, still carry much of what the people have to sell to the outer world—lambskins, cotton, wool, fruits and nuts, and carpets. They bring back loads of sugar, tea, and cloth.





AFRICA Of the seven continents, Africa is the second largest. Only Asia is larger. Africa is two-thirds as big as Asia, but it has only about one-sixth as many people.

Asia and Europe are both near neighbors of Africa. At one place only eight miles of water in the Strait of Gibraltar separate Africa and Europe. Africa and Asia are joined by the narrow Isthmus of Suez.

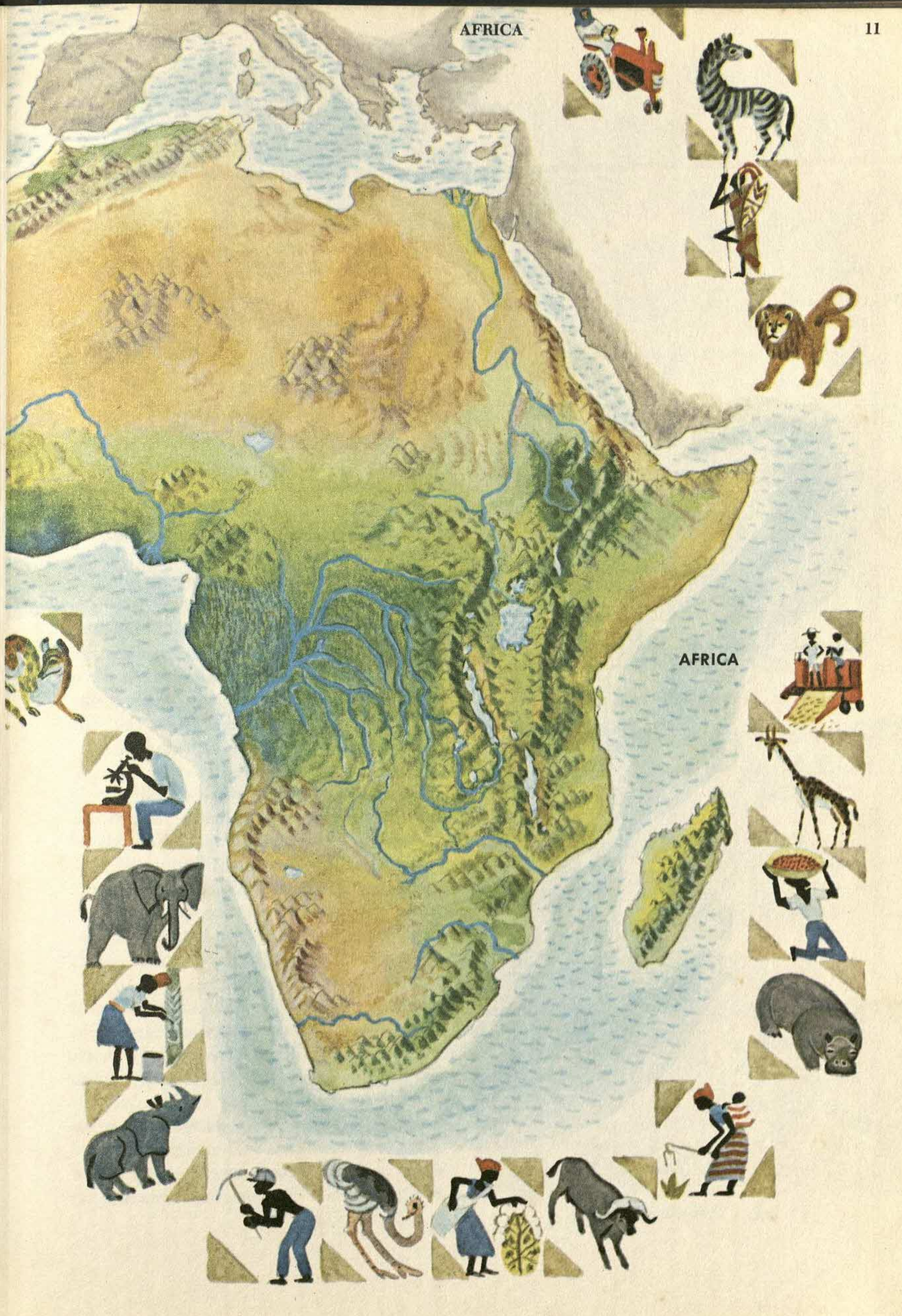
It is easy to draw an outline map of Africa. It does not have any big peninsulas. It does not have any big bays. Its coastline is almost smooth. In this way it is very different from Europe and Asia.

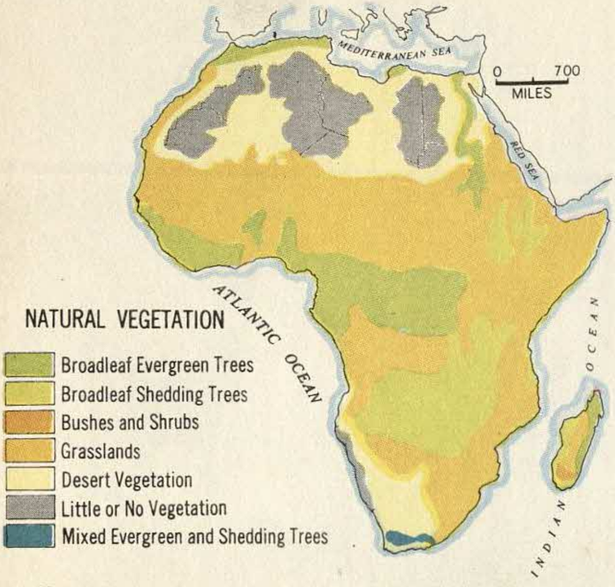
Africa is south of Europe. Many people think of it as being farther south on the earth than it is. Actually it straddles the equator. Much of it, therefore, has summer the year round. Near the equator, in the dark, tangled forests, rain falls almost every day. Farther north and farther south, in the regions of vast, sandy deserts, it almost never rains.

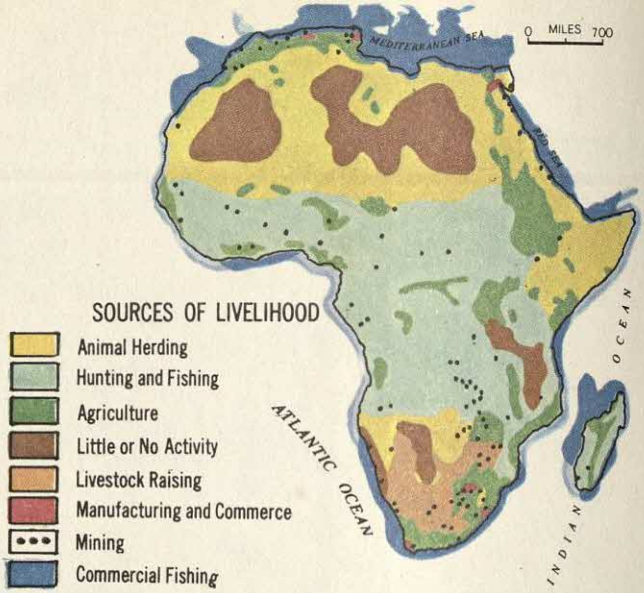
Africa used to be called the Dark Continent. It got this name because very little was known about most of it. Great parts of Africa had never been explored by the people of other continents.

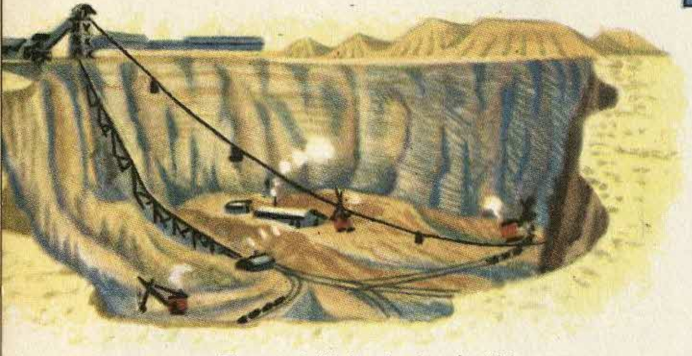
There are several reasons why Africa was a long time being explored. For one thing, traveling into it was hard. Traveling into it by land meant, in some places, chopping a way through jungle. In other places it meant crossing a desert.

Ocean boats cannot go far inland on deep bays as they can in some continents. Africa does have several large rivers, but boats cannot travel very far up most of


AFRICA







Diamond Mining in South Africa

Farming in South Africa

Arab Village in North Africa

them. Much of Africa is a great plateau high above the sea. The rivers rise in the highlands. As they come to the edge of the plateau, they fall over it in waterfalls or steep rapids. Boats cannot climb up the falls and rapids.

The coastlands that could be reached easily were, as a rule, unpleasant places to live in. Some were swampy. Some were bare rock and sand. In some places dense forest grew down to the edge of the sea. Almost everywhere heat made these coastlands uncomfortable.

The Sahara, one of Africa's two great deserts, crosses the northern half of the continent. South of the Sahara the natives are black people. When Europeans first began to explore south of the Sahara, most of the natives were unfriendly. They soon became more so, for the outsiders began capturing them and selling them as slaves in other parts of the world.

Another reason the middle of Africa was not explored sooner is that traders could get ivory and gold and slaves from the coast. They did not know about the other riches in this big continent.

But by 1870 a few explorers had gone deep into Africa and had brought out word of its riches. At the same time, some of the countries of Europe were becoming so crowded that they wanted new land to spread into. There began a scramble among the nations of Europe to set up colonies in Africa. The African natives were not strong enough to hold their own. Soon most of Africa was carved into colonies. Britain, France, Belgium, Germany, Italy, Spain, and Portugal all had colonies there.

For many years Africa remained a continent of colonies. Some of the colonies were ruled much more wisely and made much more progress than others.

Germany lost her African possessions in World War I. Italy's were taken away in World War II. After World War II a great march toward independence began. One colony after another was given its freedom by its mother country. The map of Africa has changed very rapidly. And the changes are not yet over. A map of Africa printed today may be out of date tomorrow, for changes are made almost overnight. There are still colonies eager for independence. Some of the new countries, moreover, have broken up or are in danger of breaking up into smaller countries. In 1967 nearly a third of the members of the United Nations were African countries.

The new countries of Africa have not found it easy to make their way. Many natives thought that all their problems would be over as soon as they were independent. But they soon found that freedom alone did not bring prosperity or even insure peace. There has been bloody fighting in some of the new nations.

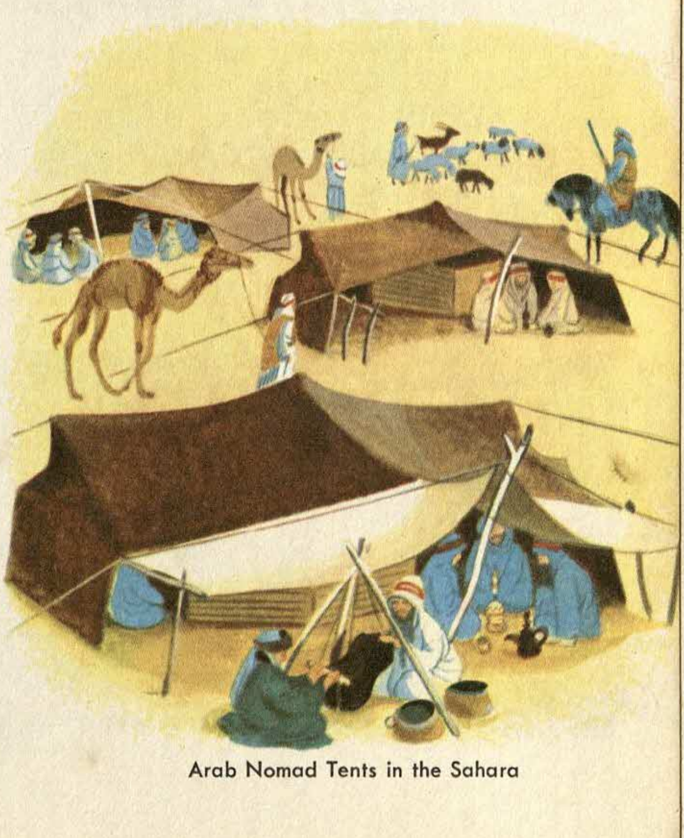
One big problem the new countries have had to face is the shortage of trained people to carry on all the kinds of work needing to be done. There are not nearly enough doctors, teachers, statesmen, or trained scientists.

Of course, all the new nations are eager to make rapid progress. And, as you see from some of the pictures, there are places in Africa with a very modern look.

In zoos we see many African animals. Lions and elephants, gorillas and giraffes,

Making Bread in a Primitive African Village

Hunting in Equatorial Africa



Arab Nomad Tents in the Sahara

Aswan Dam in Egypt

Nursing School in Ghana

Street in Durban, South Africa

Copper Mining in Rhodesia

Street in Dakar, Senegal

Logging in Nigeria

zebras, antelopes, and monkeys are among these animals. Some come from the forests. Others live in the great grasslands that border the forests. Big game hunters have killed many of Africa's wild animals. Fortunately there are now great game reserves.

There are not enough elephants left to furnish a great deal of ivory. No one is allowed to capture natives and sell them as slaves. But gold from Africa, although it cannot be washed out of the streams as easily as it once was, still makes up more than half the world's output. In addition to its gold, Africa now sells diamonds, copper, asbestos, and tin to the rest of the world. It sells uranium, too, and platinum, manganese, chromium, and cobalt. From Africa come quantities of cotton and wool for clothes, tobacco for cigarettes, sisal for rope, and palm oil for soap.

The farmers also raise big crops of olives, dates, and grapes, coffee, cocoa, tea, and kola, sugarcane and peanuts, wheat, barley, corn, and rubber.

Besides all these, there is enough iron to take care of the needs of the continent for generations to come. And there is enough water power in the mighty rivers to run thousands and thousands of factories.

Some parts of this big continent have recently-discovered riches. Until a few years ago Spanish Sahara was a sparsely inhabited desert region, supposedly good for little to Spain besides furnishing a place to train its Foreign Legion. But very rich phosphate deposits—perhaps the richest in the world—have been discovered there. Phosphates are used as fertilizer. Great stores of oil have been found in parts of the Sahara. And the tiny country of Lesotho, where the average amount earned by a worker amounted to about $50.00 a year, was in the midst of a diamond rush as soon as a huge diamond was found there in 1967.

Its old name of Dark Continent does not mean that all of Africa was unknown until recent times. When the people of Europe were still in the Stone Age, the people along

Africa's river Nile were highly civilized. They built magnificent monuments. They had an elaborate irrigation system for bringing water to dry fields. They had a written language. These people were the Egyptians. But their civilization did not spread to the rest of Africa. Instead, it mingled with other early civilizations of the Mediterranean world. The peoples to the south of the great deserts of northern Africa were left to work out their own ways of life.

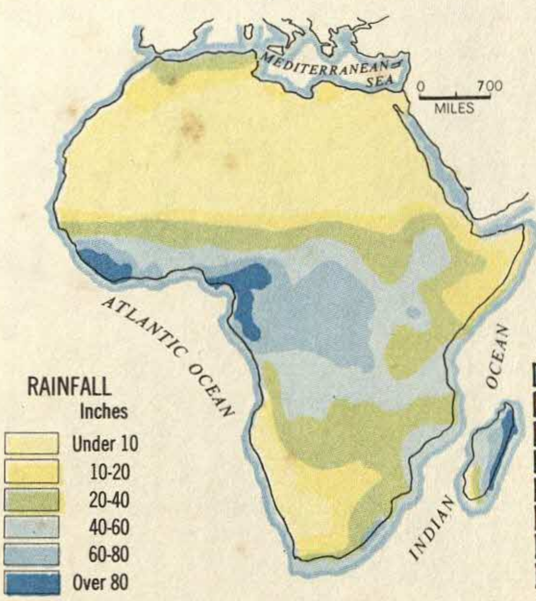
Travel in many parts of Africa is not yet easy. Except in the countries along the Mediterranean Sea and in South Africa, there are not enough good roads for automobiles. There are not enough railroads, either. More of both are gradually being added to link the rich mines and croplands in the interior of this big continent with the ports on the coast and with the factories in the cities.

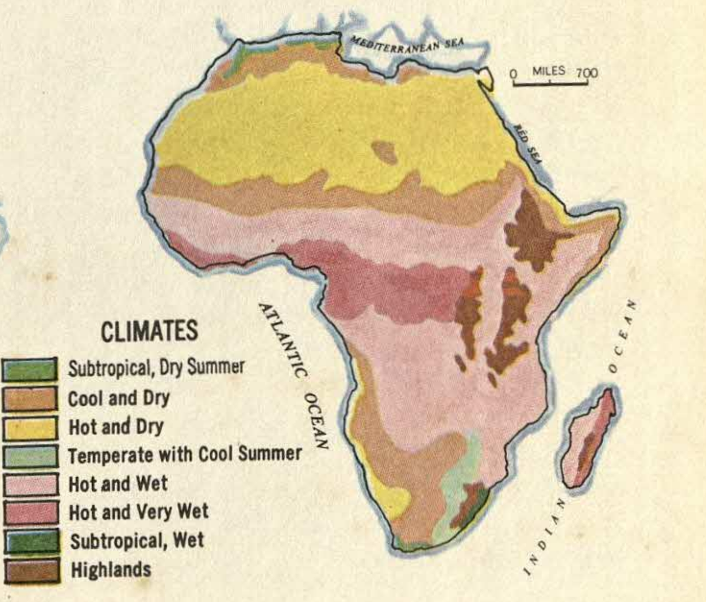
Some of the railroads that have been built are short. They run around waterfalls. Passengers and cargoes come up to the falls by boat. Then they travel around the falls by train. They take to boats again for the rest of their journey.

Airplanes are a big help in traveling in Africa. They can fly over deserts, forests, and waterfalls. They can reach places hard to reach in other ways.

Irrigation systems developed by the ancient Egyptians are still being used by some Egyptian farmers today.

Within the past few years the earliest fossils of man found anywhere in the world have come to light in Africa. Many scientists are beginning to think that it is Africa rather than Asia, as they had formerly thought, that was home to the earth's first people. (See CONGO RIVER; EGYPT; ETHIOPIA; LIBERIA; NILE RIVER; SAHARA; SOUTH AFRICA.)





AGASSIZ (AG a see), **JEAN LOUIS RODOLPHE** (1807–1873) When Louis Agassiz was a little boy, he liked to collect fishes, birds, mice, and rabbits. In their home in Switzerland he and his brother started a museum of what he called "rare and interesting living things." Louis studied science in school and college. In time he became a university professor.

Agassiz enjoyed teaching people how to study the natural world around them. He often took groups of children into the country to observe plants and animals. Many young men from the university gathered at Agassiz's home to work with him.

He became interested in the big rivers of ice called glaciers that are common in the mountains of Switzerland. He built a hut on one of the glaciers and studied the moving ice. In a book Agassiz told what he had learned about glaciers. He was the first scientist to have the idea that there was once a great Ice Age.

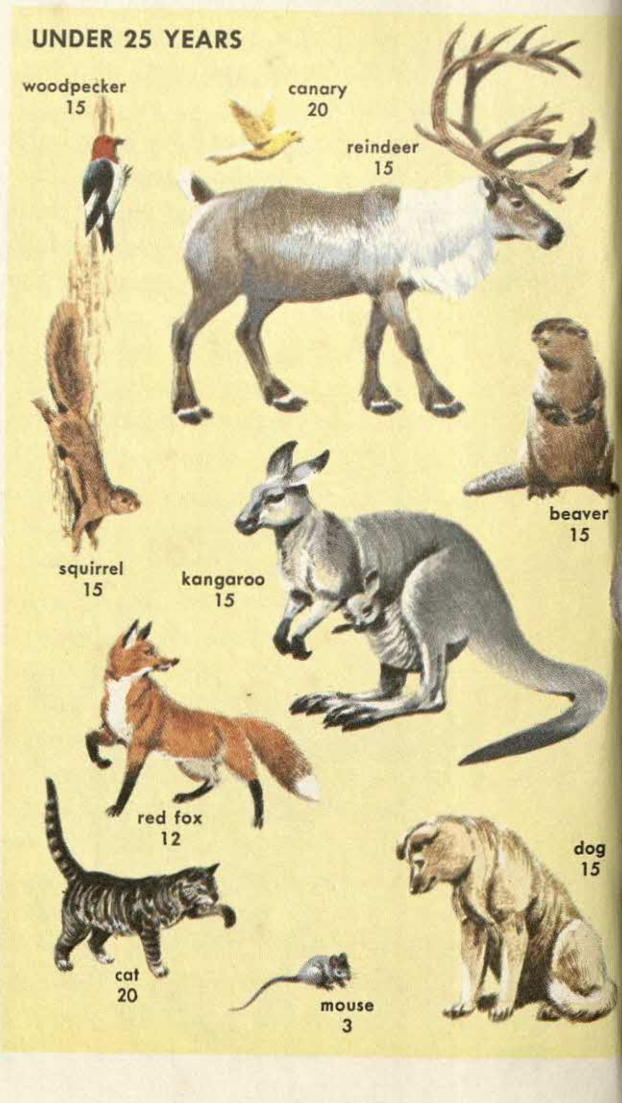
At 39, Agassiz moved to the United States and soon became America's greatest teacher of natural history. Most of his teaching he did at Harvard University. The museum he founded there is famous.

When Agassiz was old, someone asked him to tell the greatest thing he had done. The famous teacher answered, "I have taught men to observe."

AGE How old is "old"? A field mouse is old when it is only three years old. When a human being is three he is just past babyhood. A garter snake 6 years old, a goat 15 years old, and a chimpanzee 30 years old are as old as a person of 70.

The chart below tells how long a number of different kinds of animals live. It is not easy for scientists to get the figures for this kind of chart. Not many wild animals die of old age. As soon as an animal begins to get old and weak, some other animal is likely to eat it up. But scientists can study animals in zoos. Of course, they can study pet animals, too.

As animals go, man is long-lived. Only some kinds of tortoises, or land turtles, live



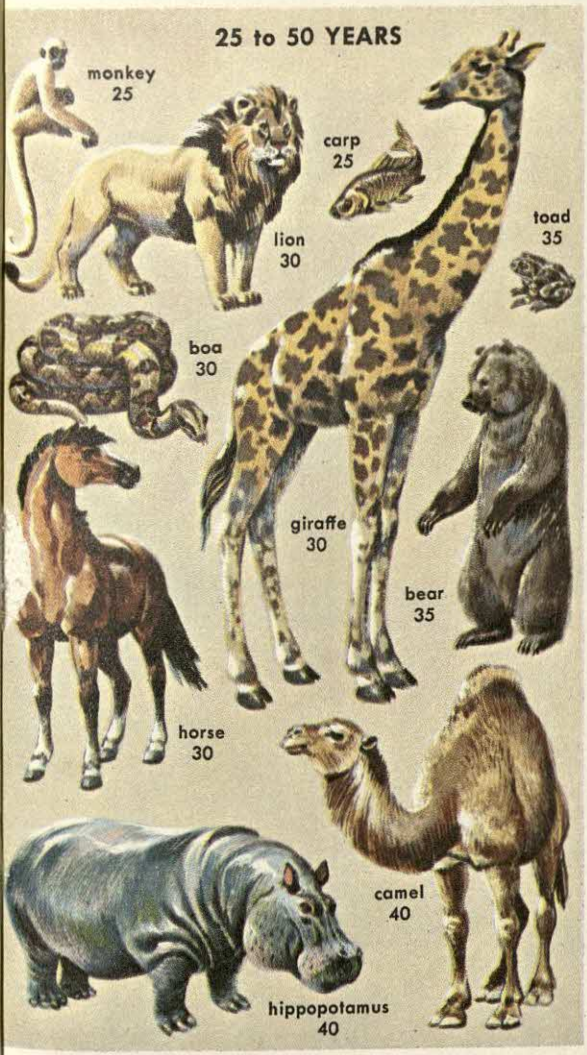
longer. Many people have wrong ideas about how old some animals live to be. Ever so many people believe that elephants and parrots live longer than people. But not many elephants, even when well cared for in zoos, live to be over 60. And parrots seldom live beyond their mid-50's.

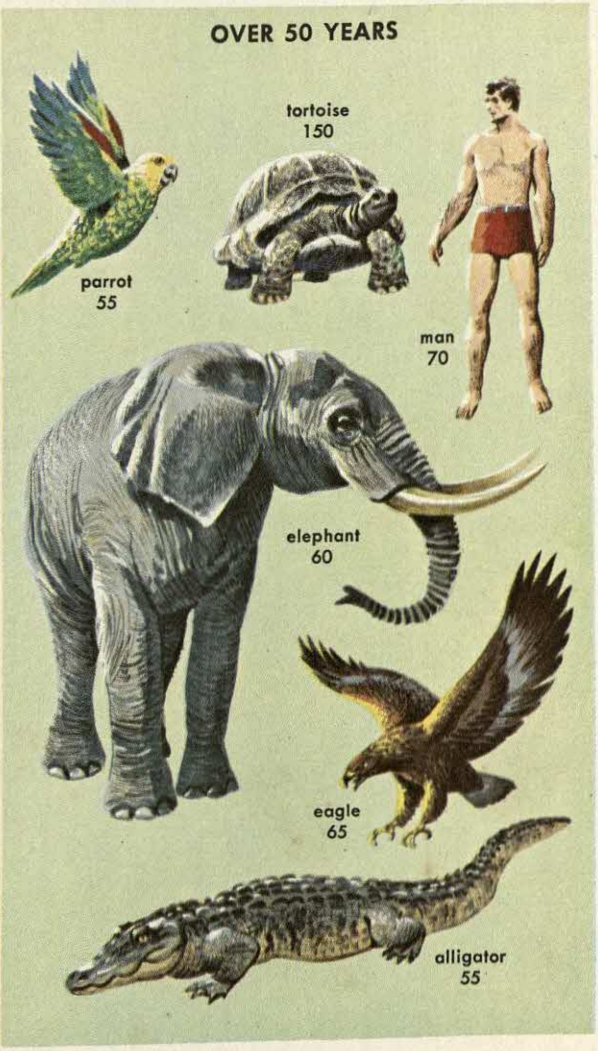
Whales are a big surprise. They are so big that anyone would think they would take years and years to grow up. But whales grow at an amazing speed. They reach their full size in just a few years. They live to be only about 40.

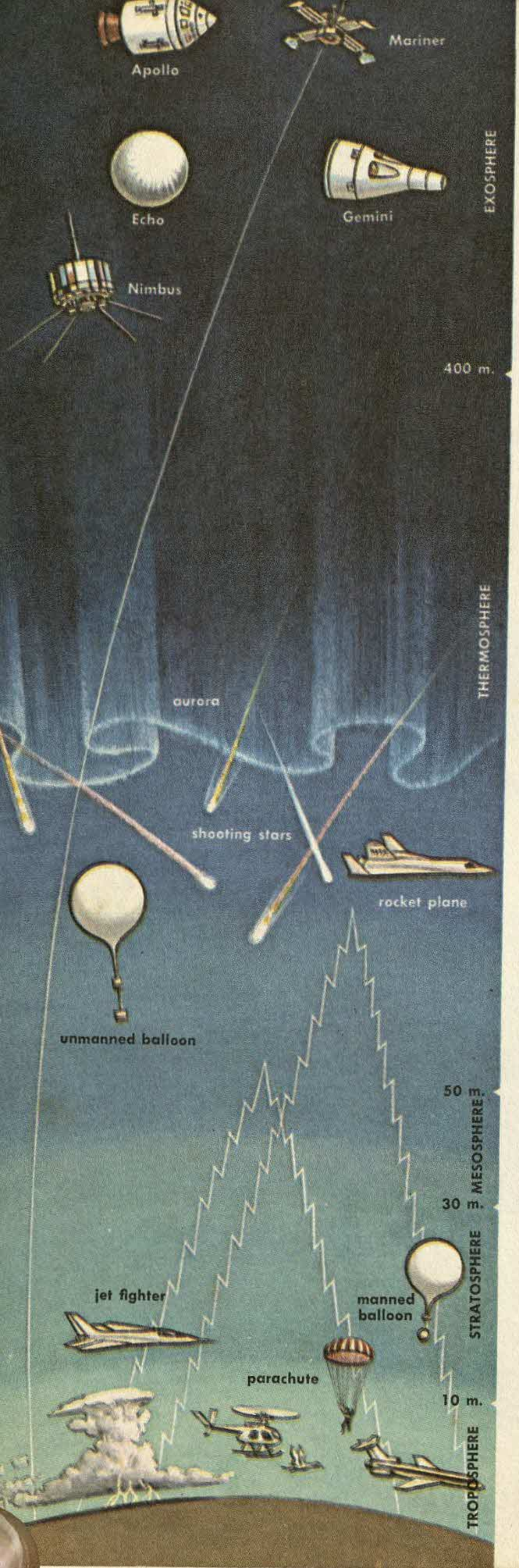
The animals named on the chart are all animals with backbones. Some animals without backbones are old in a few weeks. A housefly, for instance, almost never lives for more than a summer. Others, among them crayfishes and some kinds of snails, may live 30 years.

"Old" means different ages for different kinds of plants, too. A marigold plant is old in three or four months. Like many other plants, it grows and blooms and dies in one season. But some plants are not old when they have lived for a hundred years. They are not even old when they have lived for a thousand.

The oldest plants are trees. Some of the big trees, or sequoias, of California are more than 3,500 years old. There are bristlecone pines even older than any sequoia. The oldest trees are far, far older than any animals. (See BIG TREE.)







AIR Everywhere around us there is air. It is above us and below us and on all sides. We even have air inside our bodies. We cannot see air or smell it or taste it. We cannot even feel it unless it is moving. But we see many signs of it as we look about.

An empty bottle is not really empty. It is full of air. A glass filled with milk does not become empty as someone drinks the milk. Air goes in as the milk comes out. A really empty space is one in which there is nothing at all—not even any air.

A bottle full of air looks empty because air is invisible. It is not surprising that it is, for air is made up of gases and most gases are invisible.

There is a blanket of air all around the earth. It goes up for hundreds of miles. This blanket of air is the earth's atmosphere. The atmosphere is not the same all the way from the bottom to the top. For one thing, in the lower part of the atmosphere the particles of air are much closer together than they are high above the surface of the earth. The air, we say, gets thinner and thinner the higher it goes. It is impossible to tell where the top of the atmosphere is because the particles in the upper reaches are so very far apart.

Because of the differences at different levels scientists think of the atmosphere as in layers. Not all scientists use the same names for the different layers. The ones used on the chart are common ones.

Many men have taken trips high into the atmosphere in balloons, planes, and satellites and have found out much about it. Rockets and unmanned balloons and satellites have gone high above the earth, too. Some have carried instruments to make discoveries and send back word of them. Satellites have now gone beyond the atmosphere and on out into space.

Air does not weigh very much. The air in a box a foot wide, a foot long, and a foot deep weighs little more than an ounce. But there is so much air that all of it together weighs 6,000,000,000,000,000 tons.

On every square inch of this page the air is pushing with a force of nearly 15 pounds. Another way of saying the same thing is this: At the surface of the earth the air pressure is nearly 15 pounds per square inch. There are several hundred square inches on the surface of a person's body. The air, therefore, is pushing on you with a force of several tons. You do not notice it because you are used to it.

The air pressure at the top of a mountain is less than it is at the level of the sea. It is easy to see why. A mountain goes up so high there is less air above it.

Wind is simply moving air. Wind helps us by driving boats and windmills. The pictures above show a few other ways, too, in which the air is useful. But a picture cannot show the most important way in which the air helps us: It gives us and other living things the oxygen needed for life.

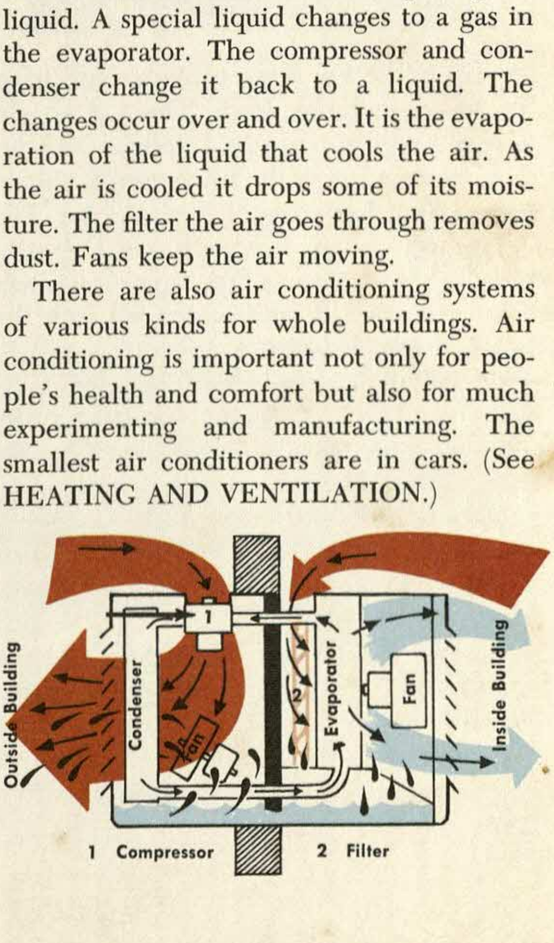
About one-fifth of the air is oxygen. Most of the rest of the air is nitrogen. But there are also small amounts of many other gases. Three of them are carbon dioxide, argon, and neon. There is always some water vapor mixed with the air around us. There is always some dust in it, too.

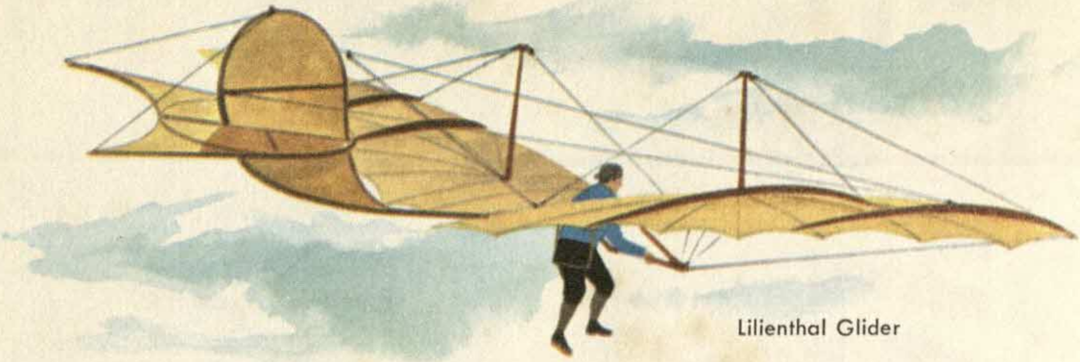
We have the earth's blanket of air to thank for the blue sky. It scatters the blue rays in sunlight. Travelers in space will look out at a black sky. (See AIR POLLUTION; LIQUID AIR; VACUUM; WIND.)

AIR CONDITIONING Small air conditioners like the one shown in the diagram are common. A conditioner of this kind is mounted in a window. It cools the air in a room or two, filters out dust, and removes some of the moisture in the air.

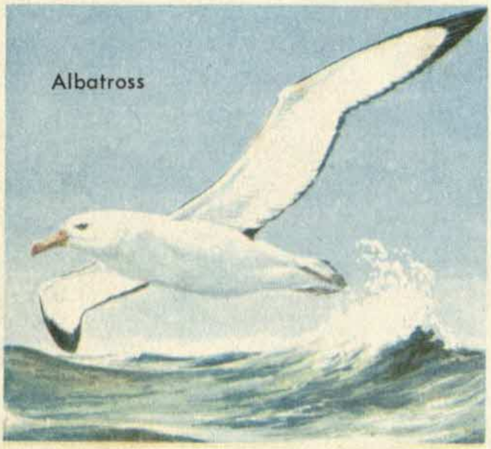
How an air conditioner of this kind cools can be told in three words: liquid—gas—liquid. A special liquid changes to a gas in the evaporator. The compressor and condenser change it back to a liquid. The changes occur over and over. It is the evaporation of the liquid that cools the air. As the air is cooled it drops some of its moisture. The filter the air goes through removes dust. Fans keep the air moving.

There are also air conditioning systems of various kinds for whole buildings. Air conditioning is important not only for people's health and comfort but also for much experimenting and manufacturing. The smallest air conditioners are in cars. (See HEATING AND VENTILATION.)





Lilienthal Glider



Albatross

AIRPLANES For many centuries men tried to fly by imitating birds. There is an old Greek myth about how Daedalus and his son Icarus tried to fly. Each used a pair of wings like the wings of a giant bird. The wings were fastened on with wax. Daedalus flew safely, but Icarus flew too near the sun. The wax melted, and Icarus fell into the sea and was drowned.

This story is only a myth. But for many hundreds of years people who tried to fly made wings that they could beat against the air. No one succeeded in flying.

Nearly 200 years ago men first went soaring up above the earth. But they were in balloons. They were floating, not flying. Balloons are lighter than air.

At last people gave up the idea of copying birds. They gave up the idea of wings that would move rapidly up and down. Early experiments with gliders—planes without engines—taught the value of using big wings that would not move.

Gliding is coasting down through the air. A glider is launched into the air at some place higher than the place where it is to land. Gravity then pulls it down. A glider builder tries to build his glider so that the air as it flows past the wings will have enough upward push to make the glider fall very slowly and go a long way forward before it lands. If the air is still, a glider never goes any higher than the place where it is launched. But a glider is often lifted by upward currents of air and goes soaring like a bird for many miles before it glides down to the ground.

Otto Lilienthal of Germany was one of the glider pioneers. In the 1890's he made more than 2,000 glider flights.

On Dec. 17, 1903, men for the first time really flew. That day Orville Wright flew for 12 seconds! Later the same day his brother Wilbur flew for 59 seconds! The Wright plane, the "Flyer," looked much like the gliders the brothers had built and flown earlier. But the "Flyer" had an engine which turned two propellers. Notice that there was no cockpit. The pilot had to lie on the lower wing.

Now that it was at last shown how men could fly, improvements came fast. Better engines were made. Better designs were worked out. Better materials for planes were found. Airplanes rapidly became bigger, faster, safer, and more comfortable.

Countries were quick to see that airplanes would be very useful in warfare. There came to be many kinds of military planes—fighters, bombers, transport planes, and others besides. There came to be many nonmilitary planes, too—cargo planes, airliners, and small private planes, some chiefly for stunt flying.

The first planes, like the "Flyer," were all biplanes. Their wings were at two levels, one just above the other. But soon monoplanes, with wings at only one level, and triplanes, with wings at three levels, appeared. So did hydroplanes, planes with floats for landing on water.

The flying of a great airliner weighing many tons seems like magic. But the same forces are acting on it that act on smaller planes. They are *lift, gravity, thrust,* and *drag.*

Lift is the upward push on a plane. *Gravity* is the downward pull of the earth. *Thrust* is the force that moves a plane forward. *Drag* comes from friction with the air the plane has to push out of its way. It tends to pull the plane back.

A plane gets the lift that keeps it aloft from the way the air flows past its wings. The wings must be shaped so that the air flows faster over the top than past the underside. Having a longer way to go makes it flow faster.

When air is flowing faster over the top of a wing, the air pressure underneath is greater than on top. If a plane is moving fast enough, the upward pressure on its wings is enough to overcome gravity. A plane must keep moving to stay aloft.

An airplane needs a runway for taking off. It must move along the ground till it is going fast enough for the wings to develop the lift they need to get the plane into the air. Big heavy planes need longer runways than small light ones.

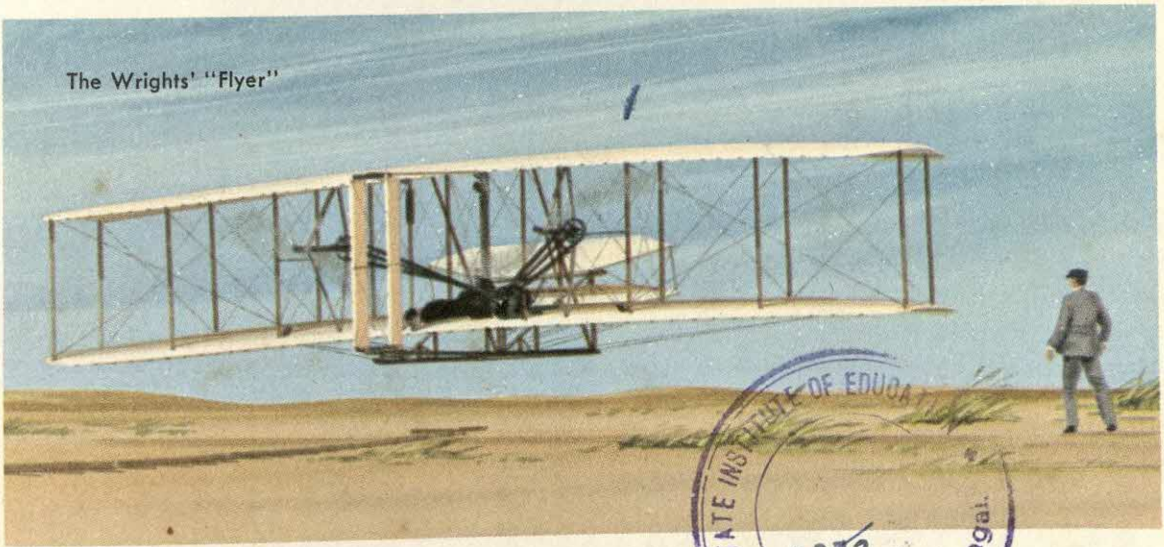
Planes are streamlined. Streamlining them is a way of lessening drag.

The thrust that pushed the "Flyer" forward was furnished by propellers driven by a gasoline engine. All the early planes had propellers. So do many planes of today.

Each blade of a propeller is shaped much like the wing of an airplane. As the propeller whirls, the pressure back of it becomes greater than the pressure ahead. The greater pressure at the back of its blades pushes the propeller forward, and the propeller pulls or pushes the plane.

The propeller is turned by some kind of engine. In most cases it is an engine much like that of an automobile. Such an engine is made up of cylinders with movable parts called pistons inside them. Propeller planes with engines of this kind are often called piston planes.

A pilot must be able to make his plane go up, go down, and turn as well as go straight ahead. He can do so because of



The Wrights' "Flyer"

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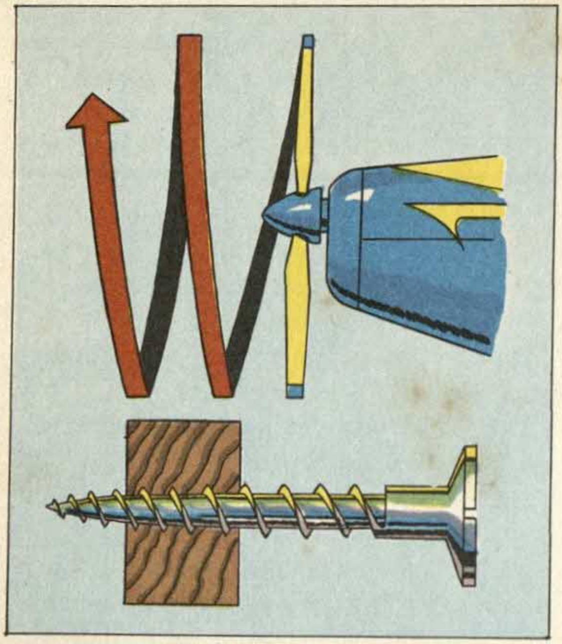
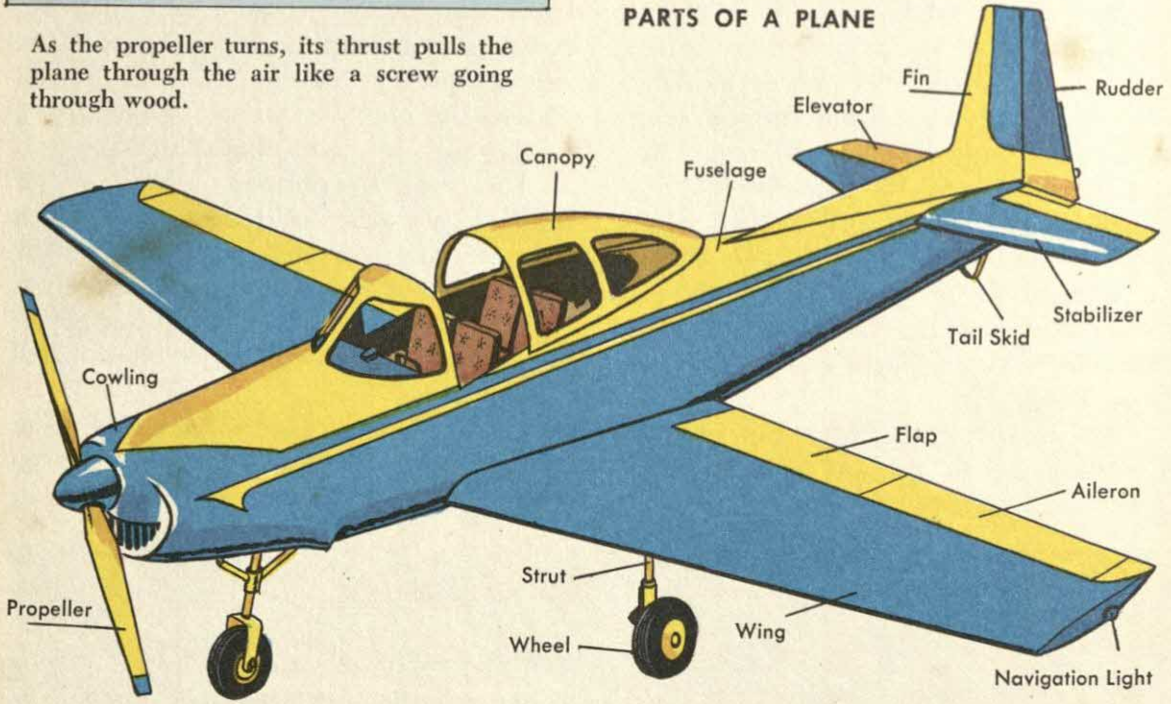
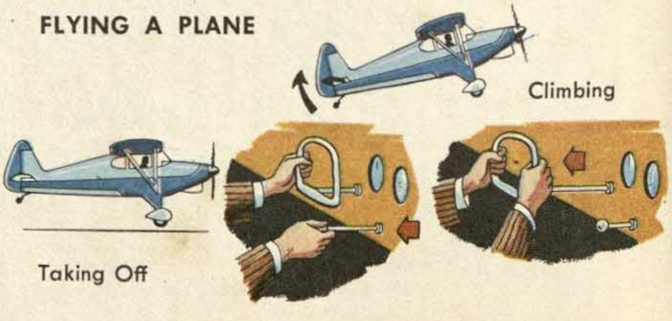


As the propeller turns, its thrust pulls the plane through the air like a screw going through wood.

PARTS OF A PLANE



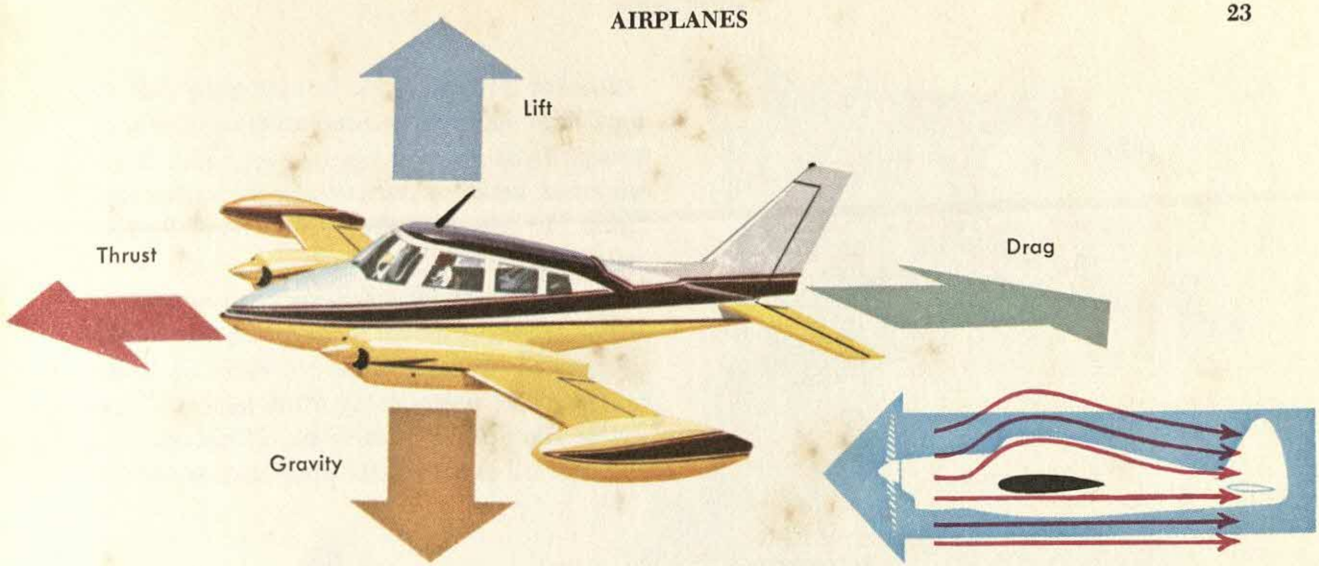
FLYING A PLANE



movable parts of the wings and tail of the plane—the ailerons, the flaps, the elevators, and the rudder. To climb, for example, the pilot raises the elevators. The air striking these elevators forces the tail down and the nose therefore points upward. The ailerons he uses in banking, or tilting, his plane for a turn. The rudder is chiefly to keep the plane in a straight path ahead. The wing flaps help in takeoff and landing. The pilot controls these parts with a wheel and pedals.

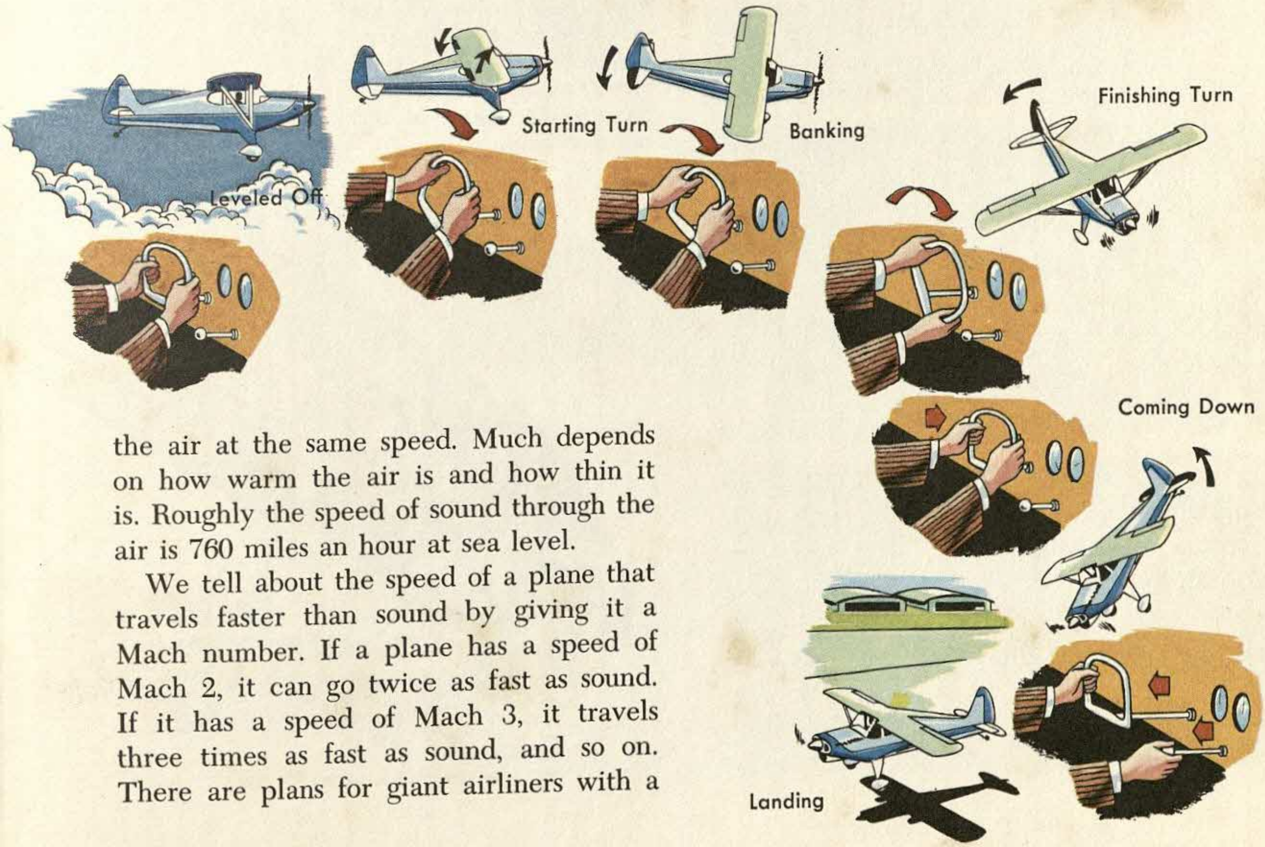
The second chapter in the story of airplanes is the story of those sent forward by jet propulsion. Jets are rapidly crowding out piston planes for many purposes. They ride smoothly. There is none of the shaking, or vibration, that comes from the engines and propellers of piston planes. They have many other advantages, too.

Inside a jet engine, fuel burns and produces great quantities of hot gases. These gases shoot out through a tail pipe at the back. The great rush of these gases backward sends the engine and its plane forward.



A great many jet planes have turbojet engines. Fuel burns very fast in any jet engine. A big jet plane must take in several tons of air a minute to give its engines enough oxygen.

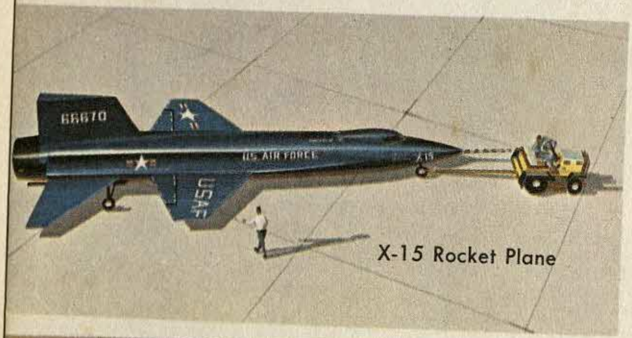
Jet planes have gone faster than any piston planes. Some of them are supersonic; they travel, that is, faster than sound. Sound does not always travel through the air at the same speed. Much depends on how warm the air is and how thin it is. Roughly the speed of sound through the air is 760 miles an hour at sea level.



We tell about the speed of a plane that travels faster than sound by giving it a Mach number. If a plane has a speed of Mach 2, it can go twice as fast as sound. If it has a speed of Mach 3, it travels three times as fast as sound, and so on. There are plans for giant airliners with a speed of Mach 3. On planes as fast as those, travelers could go around the world in about 12 hours.

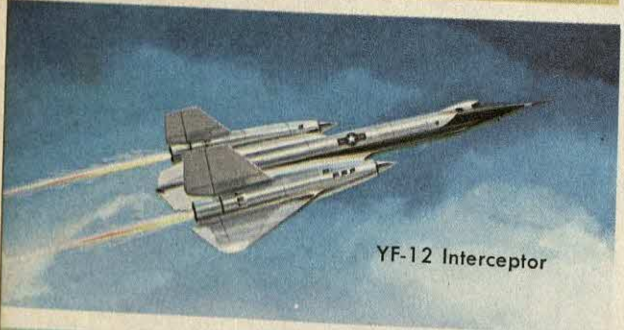
Any plane that goes faster than sound makes a great booming noise. The shock waves that cause the boom may also break windows and crack plaster walls. Supersonic planes must therefore fly especially high over regions where people live.

Fokker Triplane



X-15 Rocket Plane

F-111 Fighter Jet

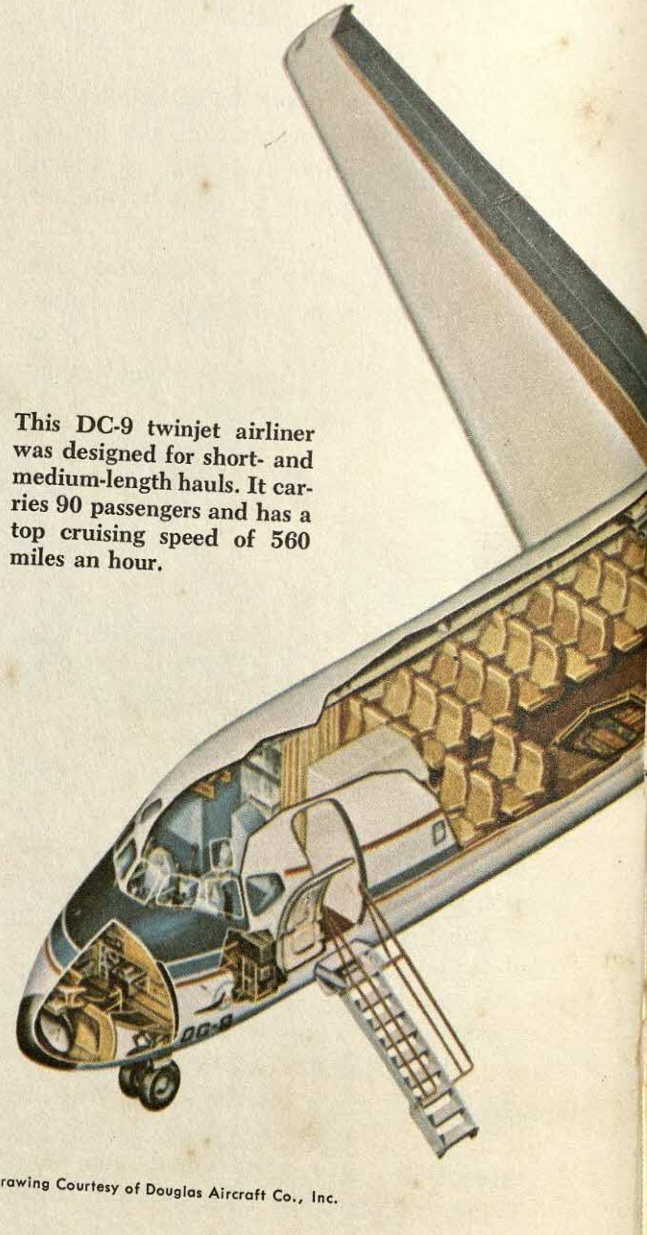


YF-12 Interceptor

Supersonic Airliner

Rocket planes work by jet propulsion, too. They have been used so far mainly as research planes in the upper air. The X-15 pictured set new records by traveling six times the speed of sound and climbing 65 miles above the ground.

The speed at which planes travel today makes it necessary for a pilot to have many instruments to help him. He must be able to tell every moment at what height he is flying, whether he is straying off his course, whether all parts of his plane are working

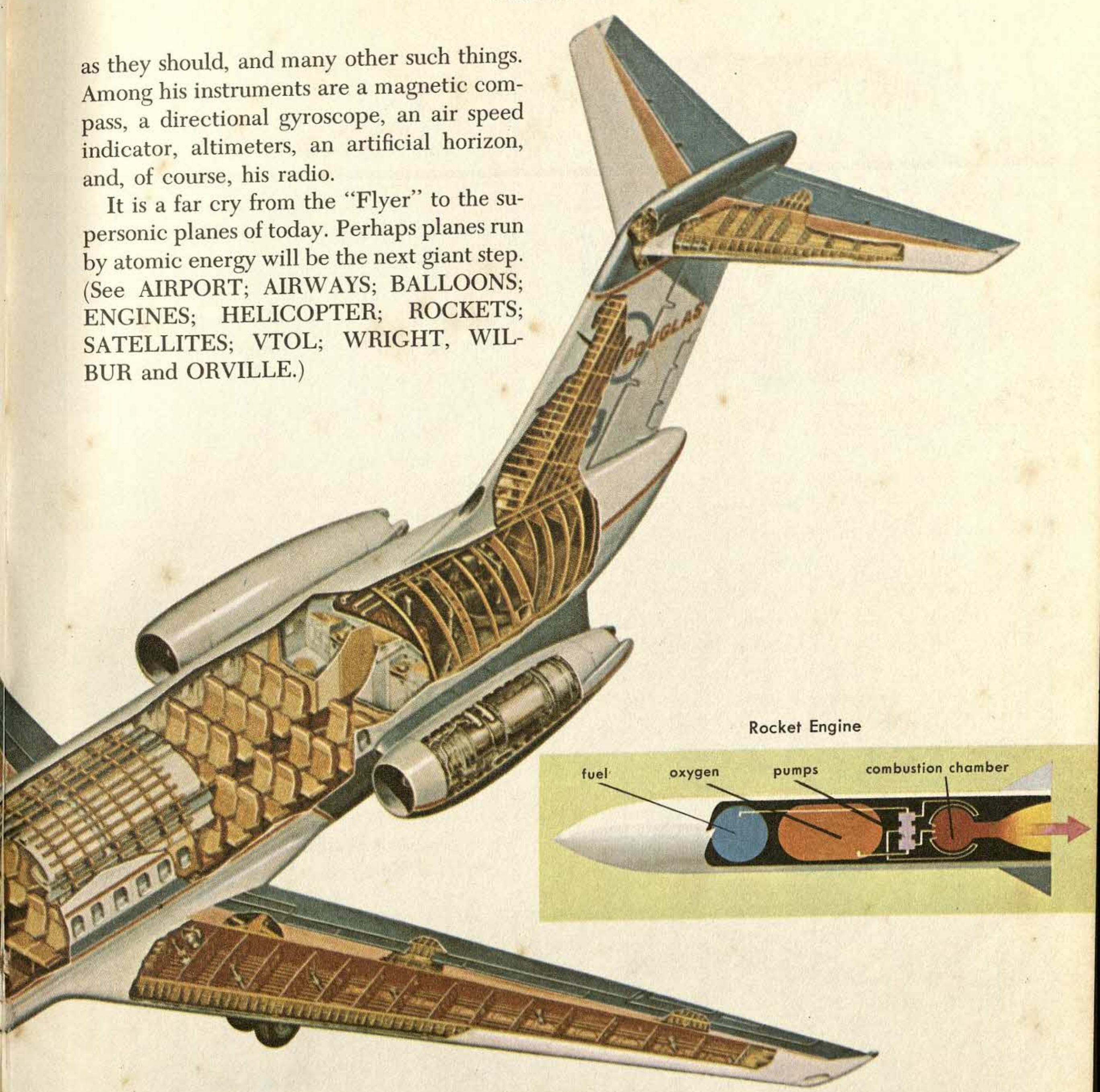


This DC-9 twinjet airliner was designed for short- and medium-length hauls. It carries 90 passengers and has a top cruising speed of 560 miles an hour.

Drawing Courtesy of Douglas Aircraft Co., Inc.

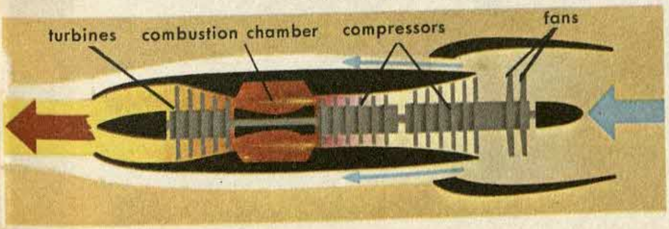
as they should, and many other such things. Among his instruments are a magnetic compass, a directional gyroscope, an air speed indicator, altimeters, an artificial horizon, and, of course, his radio.

It is a far cry from the "Flyer" to the supersonic planes of today. Perhaps planes run by atomic energy will be the next giant step. (See AIRPORT; AIRWAYS; BALLOONS; ENGINES; HELICOPTER; ROCKETS; SATELLITES; VTOL; WRIGHT, WILBUR and ORVILLE.)

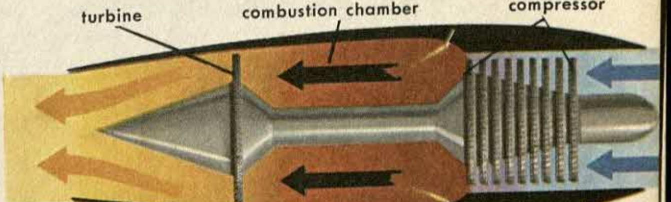


Rocket Engine

Fanjet Engine



Turbojet Engine



AIR POLLUTION "Getting a breath of fresh air" used to mean simply "getting a breath of outdoor air." But today the air out of doors, especially in big cities, is likely to be far from fresh, or pure. Enormous amounts of wastes are being sent into it. The air is polluted—made impure—by them.

At times the wastes may form a blanket over a city. Such a blanket is called smog. "Smog" is a rather new word. It was made from the two words "smoke" and "fog."

The smoke in smog does not all come from smokestacks. A great deal of it comes from the exhausts of trucks, buses, and automobiles. Some comes from the burning of rubbish. In the smog there may also be fumes from chemical plants and smelters.

Smog makes people pay great sums of money for cleaning. It may be so dense that it hinders traffic. It damages paint and makes some metals deteriorate fast. It may kill trees and other plants. But the chief reason that air pollution is a serious problem is that it affects people's health. The danger grows as more and more cars, trucks, airplanes, and factories are built. Some scientists say that if we do not solve the problem of air pollution soon, the earth will no longer be livable.

Ways are being worked out of making fuel burn more completely and therefore throw away less waste that is harmful. Electricity is being used instead of fuel. Laws against smoke are being passed. But still much needs to be done. (See SMOKE.)

AIRPORT All big cities of today have airports. Some have several. Many small cities and towns have airports, too. An airport spreads out over a great deal of space because there must be long runways for landing and taking off.

Airports where big airliners come and go are all much alike. Besides their runways they have waiting rooms, ticket offices, information desks, and counters where baggage is weighed in. Many of them have

restaurants and bars, bookstores, gift shops, and barbershops. They all have buildings called hangars for planes not in use.

Air traffic at an airport is managed from a control tower. The men in the control tower watch the incoming planes on radar screens and talk to the pilots by radio. They tell them when to land and what runway to use. They may order a plane to circle the field for several minutes waiting for a clear runway. In bad weather they may tell a pilot to fly on to some other airport. The men in the control tower talk with the pilots who are about to take off, too. They tell them when to take off and what runway to use.

Many other kinds of work go on at an airport. Tickets are sold. Baggage and freight are weighed and loaded. Weather instruments are read, and weather reports are studied. Food is put aboard. Planes are checked and fueled, and any needed repairs are made. Ground workers are busy day and night keeping our airplanes flying.

There are many great airports. Busiest of them all is the O'Hare International Airport in Chicago. On some days at O'Hare there are more than 2,000 landings and takeoffs—an average of more than one a minute.

Since airports take up a great deal of space, many of them have to be far from the centers of the cities they serve. Going from Buenos Aires to its airport means a trip of 32 miles!

AIRWAYS A big airliner roars by overhead. Nothing else is in sight in the sky. The pilot, it seems, can go where he pleases. But he is really following a road just as carefully as if he were in a car on the ground, and he must stay on that road unless he has permission to change. The roads through the air are called airways.

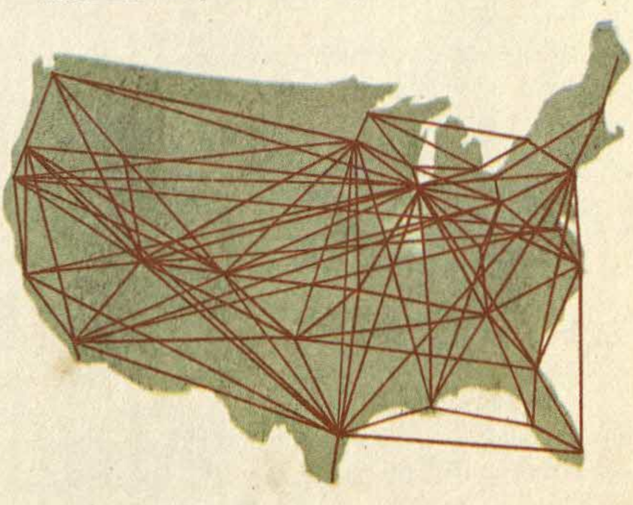
Airways are much broader than highways for automobiles. As a rule they are about ten miles wide. Besides, an airway extends for miles up and down. The flight plan a pilot makes before he starts on a trip must tell not only what airway he will follow but also at what height he will fly.

Highways have signs to guide motorists and to control traffic. Airways cannot be marked with such signs. A pilot must get help from special instruments in his plane and from stations on the ground. In good weather landmarks and lights help guide a pilot. Even then he needs instruments, too. And in bad weather he may have to depend entirely on instruments and radio messages from ground stations.

In the United States a plane within 30 miles of an airport gets all the information and directions needed from the airport's control towers. Away from the airport there are centers that send out radio signals and give other help. Scattered along the airways there are also flight service stations. They are always ready with information about weather and traffic.

As you would expect, control centers are fewer over the oceans than on land. Planes crossing the North Atlantic, for instance, are controlled from airports in New York, Gander in Newfoundland, Shannon in Ireland, Prestwick in Scotland, and the Azores.

The map shows some of the airways that crisscross the United States. A number of other countries have many airways. Some countries still have few. Airways, however, reach parts of the world that railways, highways, and seaways do not reach. (See AIRPLANES; AIRPORT.)



ALABAMA As one can see from this small map of the United States, Alabama is a southern state. The Gulf of Mexico forms part of its southern boundary. In size Alabama ranks 29th among the states. In population it ranks 21st. Its four leading cities are Birmingham, a center of steelmaking; Mobile, a port on the Gulf; Montgomery, the capital; and Huntsville, a fast-growing "space age" city.

"Yellowhammer State" and "Heart of Dixie" are nicknames for Alabama. But "Cotton State" is a more common nickname. In its early days Alabama had great cotton plantations worked by slaves. Today millions of dollars' worth of cotton is still raised on its farms each year. But much of the land once used for cotton is now used for corn, peanuts, tobacco, soybeans, and sweet potatoes, and for stock raising.

As the map shows, hogs and cattle are raised chiefly on the lower lands of the southern half of the state. Poultry raising has become important in the state in the last several years, too. Alabama is now one of the leading poultry states. In a recent year its poultry farms sold nearly 75 million eggs.

The forests, which cover about half the state, give jobs to many. These forests furnish turpentine, tar, pitch, resin, pulpwood for papermaking, and lumber. The trees of the forests are chiefly conifers. Longleaf pine, sometimes called Georgia pine or southern pine, is one of the most important.

Agriculture is still important to Alabama, but industry is increasing at a rapid rate. The northern part of the state has become a region of mills and factories.

Alabama is fortunate in having many rivers along which large boats can travel. The Mobile, Tombigbee, and Black Warrior rivers form a great inland waterway.

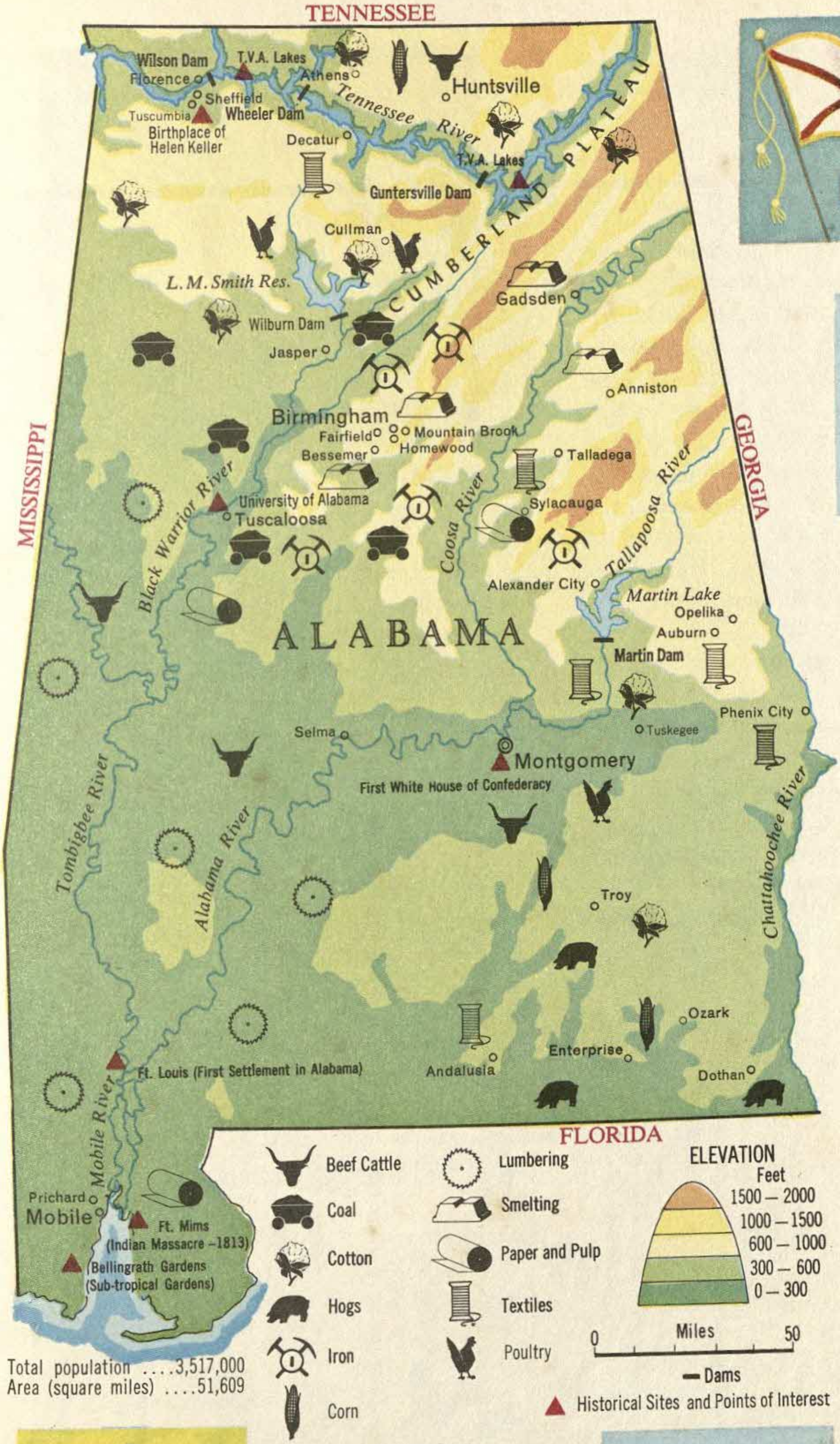
Cheap electric power from dams built across the rivers of Alabama has brought to the state many mills for making cotton cloth. Here, too, is one of the few places in the world where all three materials necessary for steelmaking—iron ore, coal, and limestone—are found together. Alabama produces much steel, and many products are manufactured from it. So much steelmaking goes on in Birmingham that it is called the "Pittsburgh of the South."

Huntsville is famous as a space and rocket research center. Since World War II it has grown from a city of 13,000 to one of almost 150,000. Mobile is a busy port. The Mobile River, which big boats can use, empties into the Gulf there. Steel from Birmingham is used to build ships in shipyards nearby. Shrimp boats move about in the harbor. Many tourists visit Mobile to see its beautiful homes and gardens and to fish for tarpon in the Gulf.

The first Europeans to see Alabama were Spanish explorers. We know that De Soto fought a bloody battle there against the Indians in 1539 while on his way westward to the Mississippi. But there were no permanent settlements in the state until 1702. In that year the French governor of Louisiana founded Fort Louis on the Mobile River. A few years later the settlement was moved farther south to where Mobile now stands.

In 1813 the Creek Indians attacked Fort Mims, not far from Mobile. They killed several hundred Alabama settlers. General Andrew Jackson was sent to fight these Indians. He defeated them at Horseshoe Bend, and the Indians gave up to the United States a large part of the land they held.

Alabama became a state in 1819. It was the 22nd state to enter the union. During the Civil War Alabama withdrew from the Union and joined the Confederacy. In fact, Montgomery, Ala., was the first Confederate capital. In 1868, after the war had ended, Alabama rejoined the United States.



Total population 3,517,000
Area (square miles) 51,609

State Flower: Camellia

State Bird: Yellowhammer

Southern Mansion

Shrimp Boat

Confederate White House

ALAMO "Remember the Alamo" was a battle cry in the last part of the war Texas fought to free itself from Mexico. The war was fought in 1835 and 1836. The people who were fighting to free Texas were Americans who had settled there.

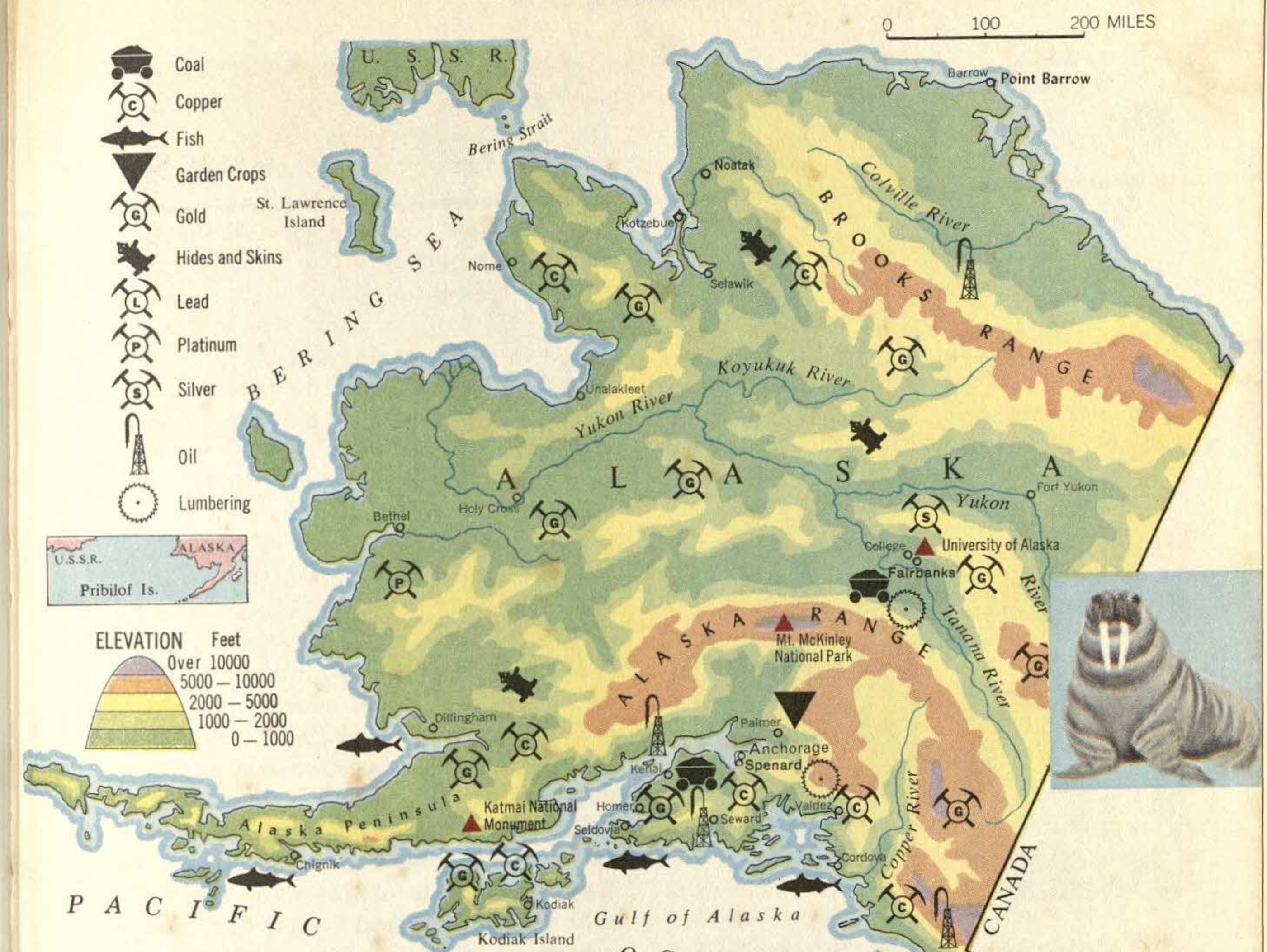
The Alamo was first a mission. It was founded in 1718. Later, as the city of San Antonio grew up around it, it became a fort. On February 23, 1836, the Mexican general Santa Anna led an army of about 4,000 soldiers against it. Inside the Alamo there were fewer than 200 Texans. But the Texans fought so bravely that it was 13 days before Santa Anna could take the Alamo. Every man inside the fort was killed. One was Davy Crockett, the famous pioneer scout. Another was Jim Bowie, the inventor of the bowie knife.

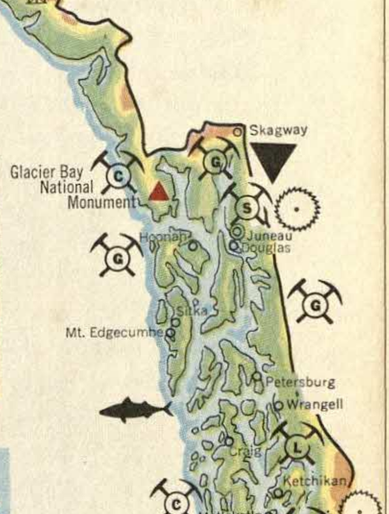
The cry "Remember the Alamo" aroused all of Texas. Within two months a Texas army under Sam Houston captured Santa Anna. Soon the Texans had their freedom. Later, in 1845, Texas became a state.

Today the Alamo is one of the sights of San Antonio. The state of Texas bought it to be a monument to the freedom of Texas and to the heroes who died defending the fort. (See TEXAS.)

ALARIC (370?–410) About 1,550 years ago a horde of barbarians, the Visigoths, marched on Rome. Their fiery leader Alaric did not intend to capture Rome. He simply wanted the Roman emperor to hire his men as soldiers and to give them land. The emperor made promises, but he did not keep them. In the end the Visigoths took Rome. Soon afterward Alaric died.

His chiefs made their Roman captives change the course of a small mountain river. Then the captives dug a grave for Alaric and his treasure in the old riverbed. After the grave was filled, they turned the river back into its old bed. The river has kept the secret of the burial place.





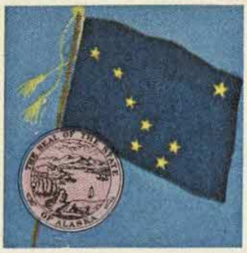
▲ Historical Sites and Points of Interest

Total state population 272,000
Area (square miles) 586,400

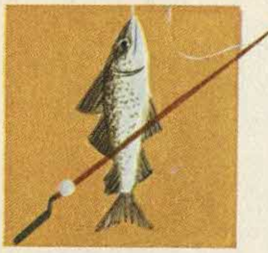
ALASKA On July 7, 1958, the President of the United States signed a bill to make Alaska the country's 49th state. Alaska is by far the largest of all the states. It is more than twice as big as Texas. The western tip of Alaska's mainland is only 55 miles from the Soviet Union.

Although it was not officially a state till 1959, Alaska celebrated in 1967 its 100th birthday as a part of the United States. In 1867 the country bought Alaska from Russia for $7,200,000. This sum is tiny compared to the value of the salmon, furs, gold, copper, petroleum, and lumber which Alaska now produces each year. But in 1867 most Americans thought the country had bought land that was just "an icebox." They called it "Seward's Folly" after William H. Seward,

Mt. McKinley


THE SEAL OF THE STATE OF ALASKA

State Bird: Willow Ptarmigan
State Flower: Forget-me-not



the secretary of state who arranged for its purchase.

Alaska is far to the north. Part of it might be called an icebox. But in some parts of Alaska the climate is surprisingly mild. Juneau, the capital, is almost 1,500 miles farther north than Washington, D.C. But a summer day in Juneau may be as warm as the same day in Washington.

Most of Alaska is a big peninsula on the northwest corner of North America. But there is also a narrow strip of land that stretches southward along the Pacific coast. There are many islands, too. Among them are the tiny Pribilofs. They are the home of the fur seals. And there is the long chain of the Aleutians. The westernmost of these islands is due north of New Zealand.

Alaska has mountains and glaciers. The highest mountain in all of North America is there. It is Mount McKinley, 20,320 feet high. Alaska also has active volcanoes. The Yukon is Alaska's one great river.

The northern shores of Alaska border the Arctic Ocean. They are the "icebox." The winters are not only long and cold but also dark. In the middle of the winter the sun does not appear for days or even weeks at a time. Eskimos, with their herds of reindeer, live in this part of Alaska.

In the southern part of the peninsula the winters are long and cold and the summers short. But in the long summer days gardens grow so fast that magic seems to be at work. One cabbage may weigh 50 pounds.

Fishing is Alaska's most important industry. Hundreds of millions of pounds of salmon, halibut, and king crab are caught each year. Lumbering ranks second.

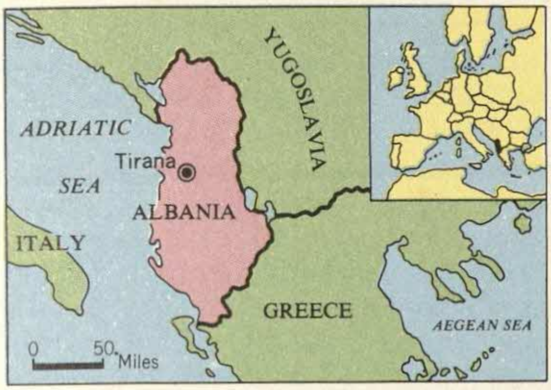
The hunt for gold brought many pioneers to Alaska. Gold is still mined, along with coal, silver, copper, platinum, and lead. But now oil, not discovered until 1957, is the state's leading mineral product.

Several of Alaska's larger towns are in the narrow southeastern strip. Juneau is here. The climate of the whole region is mild, and there is much rain. Each town is hemmed in by mountain and forest and sea. The scenery is beautiful.

A railroad links Skagway, Alaska, with Whitehorse, Canada. The one railroad within the state joins Seward, Anchorage, and Fairbanks. There is much air travel in and to Alaska. There are only a few cities of more than 5,000 people in the state, but there are several hundred landing strips for planes. Cars reach the state by ferry and over the Alaska Highway built in 1942.

Alaska is not at all crowded, but it is growing. Since 1940 its population has more than tripled. Anchorage, its largest city, was a town of 3,500 in 1940. Today it is a city of more than 50,000.

The name Alaska comes from the Eskimo language and means "mainland." "The Last Frontier" is the state's nickname. The state song is "Alaska's Flag."

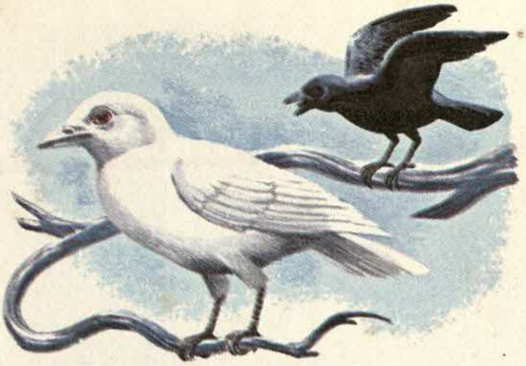


ALBANIA The Balkan Peninsula reaches southward from Europe into the eastern part of the Mediterranean Sea. The peninsula is divided among several countries. The smallest of them is Albania.

Much of Albania is covered with rugged mountains. Many of the roads there can be traveled only by pack ponies or donkeys. A narrow, swampy lowland lies along the coast. Albania's summers are hot and dry; its winters are cool and rainy.

Albania is the most backward country in Europe. It has very little industry. Most of its people are farmers. Their main crops are corn, wheat, sugar beets, and tobacco, but the yields are poor. Much of the farming is still done in old-fashioned ways. There is little modern farm machinery.

Albania has had a troubled history. The Balkan Peninsula has been the scene of many wars. Albania itself has been ruled, at one time or another, by Turkey, Serbia, Greece, Bulgaria, Italy, and Germany. After the Germans were driven out at the end of World War II, Albania adopted a Communist form of government. It is now closely tied to Communist China.



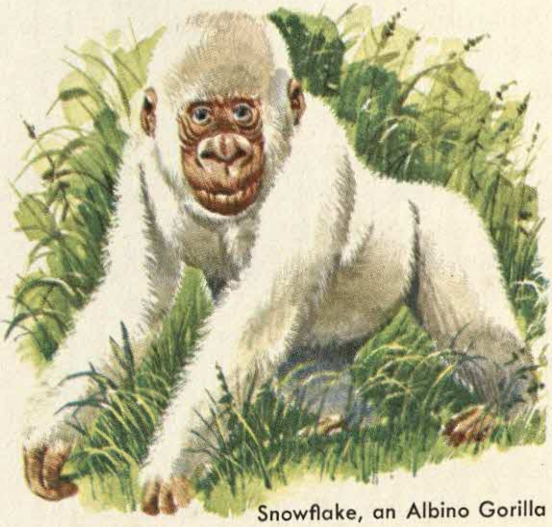
ALBINO The birds in the picture are both crows. But one is certainly not "as black as a crow." It is an albino. "Albino" comes from a Latin word that means white. Albinos have no coloring matter, or pigment, in their skin, fur, scales, or feathers.

Albinos have poor eyesight. Their eyes are usually pink from the blood in tiny blood vessels there.

White mice, white rabbits, and white rats are albinos. There are albino robins and horses and skunks. Albinos, in fact, are found among a great many kinds of animals. There are even albino people.

Snowflake, pictured below, is an albino gorilla. No albino gorilla was on record before he was found in Africa in 1966.

Wild animals that are albinos seldom live long. Their weak eyes and white bodies make them easy prey for their enemies. (See WHITE ELEPHANT.)



Snowflake, an Albino Gorilla

ALCHEMY (AL ke mee) The chemistry of the Middle Ages was called alchemy. Both names are believed to have come from *Khem*, an ancient name for Egypt.

Alchemy was not like the chemistry of today, because the alchemists were not good scientists. They did not carry on careful experiments as scientists do now. Many of them counted on magic to make their dreams come true.

The laboratories where the alchemists worked were dark, gloomy places. They were filled with bad odors. The shelves and tables were crowded with flasks and bottles of queer shapes and sizes. Papers covered with mystic signs were strewn about. There was none of the order we find in today's laboratories.

One of the dreams of the alchemists was to change cheap metals into gold. Their idea was that other metals were really impure forms of gold, the "perfect" metal. They tried to make a magic substance which they called the "philosopher's stone." The philosopher's stone, they claimed, would not only change other metals to gold, but would also cure diseases and keep people young.

Kings hired alchemists to find the philosopher's stone for them. They paid some of them big sums of money because the alchemists claimed they already knew the secret. But of course none of them did. They made all sorts of weird mixtures and heated them over their fires, using strange words and gestures to add just the right magic touch. But no philosopher's stone appeared. At last alchemists had such a bad reputation that alchemy died out.

Alchemists, however, did much good. They discovered several new metals. They discovered some new chemicals. They found better ways of making glass and dyes. Some of the apparatus chemists use today was first made by alchemists. Indeed, the good things they did were the foundation of today's chemistry.

ALCOHOL There are many kinds of alcohol. Grain alcohol and wood alcohol are two common kinds.

Grain alcohol gets its name because it can be made from such grains as corn and barley and rye. It can also be made from molasses, potatoes, and fruits. Tiny plants called yeasts are used in making it.

Grain alcohol is the kind of alcohol found in such drinks as wine, beer, and whiskey. Drinking too much of an alcoholic drink makes people do strange things. It makes them stagger when they try to walk. It makes them talk strangely, too, and not very intelligently. They cannot drive a car safely. They cannot be depended on to do anything that requires careful thinking.

Wood alcohol, as its name tells, can be made from wood. It is poisonous.

Many millions of gallons of alcohol are used in the United States every year. Much of it serves to dissolve substances which water will not dissolve. Many varnishes, perfumes, and hand lotions are part alcohol. So are many medicines. Alcohols of one kind or another go into the making of substances as different as nitroglycerin, fibers for cloth, and antifreezes.

Alcohol will not freeze until the temperature is very, very low. For this reason it is better than mercury for thermometers that are to be used where it is very cold. In thermometers, as a rule, the alcohol is colored.

Much alcohol is used today as a fuel. It burns with a hot, blue flame. There is no smoke. (See YEASTS.)

ALCOTT, LOUISA MAY (1832–1888) The home of Louisa May Alcott in Concord, Mass., has thousands of visitors every year. Her book *Little Women* is one of the most popular books ever written for girls. It tells the story of four sisters, Meg, Jo, Beth, and Amy. It is really the story of the Alcott family, and Jo is Louisa herself.

As a child, Louisa wrote plays in which she was the leading actress. Her three sisters and the neighbor children took the other parts. Ralph Waldo Emerson and Nathaniel Hawthorne, both famous writers, were neighbors of the Alcotts. Often their children were actors in Louisa's plays.

Louisa's father was never much of a moneymaker. When Louisa was only 15, she began helping to support the family. During the day, when she was sewing or taking care of children, she planned stories. At night she wrote them down. She sold her first story when she was 16. Her first whole book was a collection of fairy tales.

Louisa May Alcott had been writing for nearly 20 years when her publishers asked her to write a book just for girls. At first she did not want to, but finally she agreed and wrote *Little Women*. No one was more surprised than she that it was so popular. Then came a whole series of stories much like it. Among them are *An Old-Fashioned Girl, Little Men, Eight Cousins, Rose in Bloom,* and *Jo's Boys.*

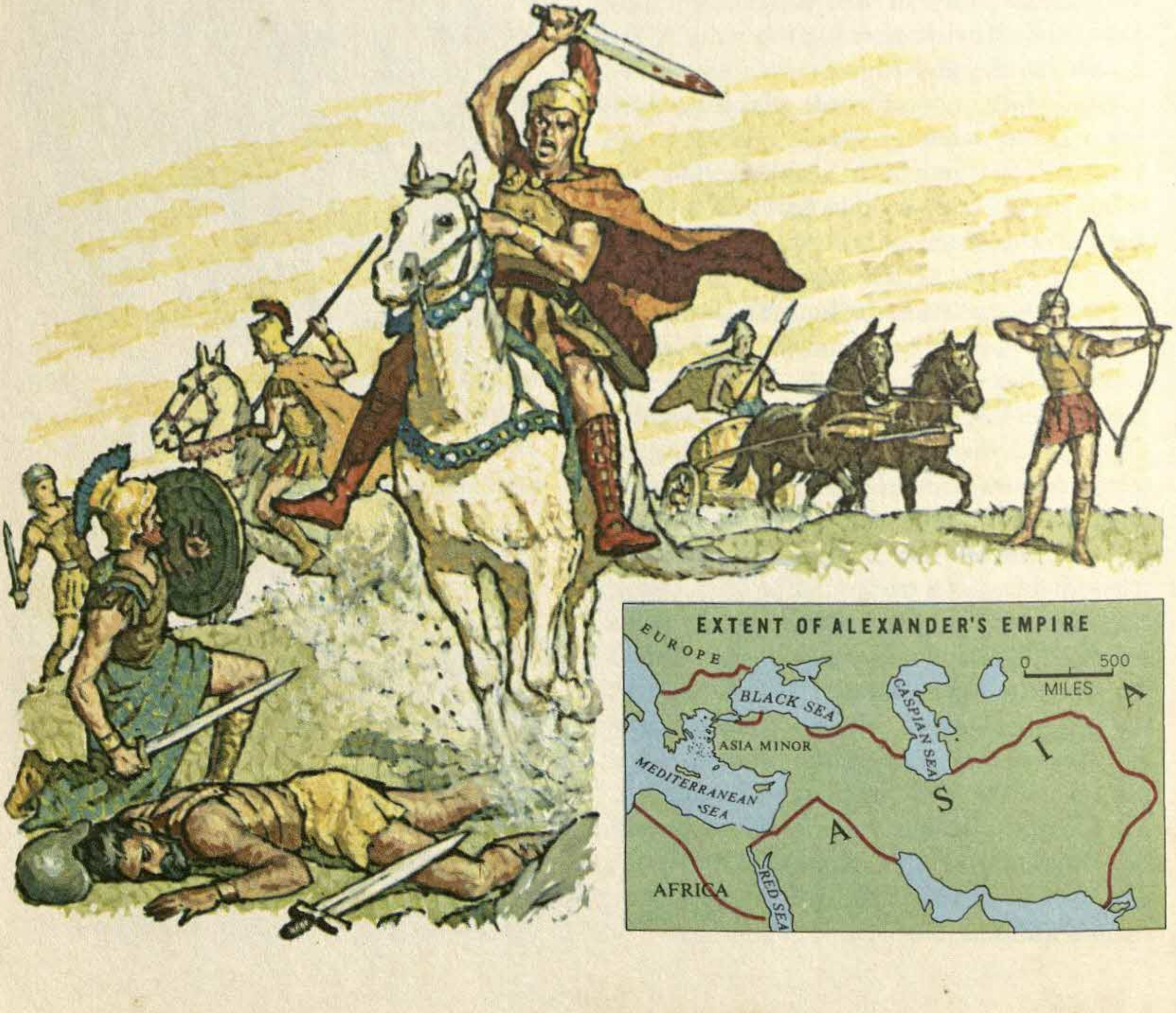
ALEXANDER THE GREAT (356-323 B.C.) As the dates show, Alexander the Great lived more than 2,000 years ago. When he was not quite 20, he became the king of Macedon, a small country north of Greece. He lived to reign only 13 years, but in that time he built up a great empire.

Alexander's father was King Philip of Macedon. His tutor was the famous Greek philosopher Aristotle. One story of Alexander as a boy tells how he trained a high-spirited horse. He learned that he had to be patient. If he lost his temper, he could not manage the horse. Another story is that Alexander worried for fear there would be no lands left for him to conquer.

In those days Greece was made up of many small city-states. Philip conquered most of them. These Greek states rebelled when Alexander became king, but he soon won them back. Then he marched against Persia. Persia was very strong. But Alexander's generals were the best in the world. Alexander himself was in the thick of every battle. Persia fell before him. So did Egypt. So did all the lands to the east as far as India.

In India Alexander's soldiers refused to go farther. They were weary of fighting, and the 5,000 elephants in India's army terrified them. Alexander therefore turned back. Three years later he died of a fever.

Alexander was more than a great soldier. He founded cities in the lands he conquered. One of them was Alexandria in Egypt. He carried the ideas of the Greeks to many new places. He tried to unite the peoples he conquered into one people. Of course, Alexander had faults. But he ranks high among the rulers of ancient times.



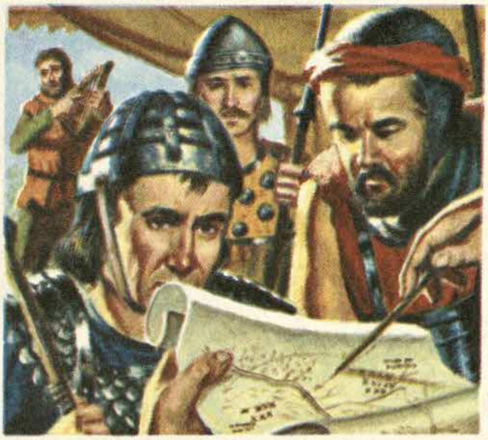
ALEXANDRIA Soon after Alexander the Great conquered Egypt he laid out a new city on the delta of the Nile. He named the city Alexandria after himself. Before long Alexandria was one of the most important and beautiful cities in the world. It was a great trading center. In Alexandria, so an ancient saying went, you could get anything except snow.

Alexandria was also a center of learning. Ptolemy I (TOL e mee), who followed Alexander as the ruler of Egypt, founded a library there. This library became the most famous of ancient times. At one time it had about 700,000 books in it. These books were not like the books of today. Instead, they were roll books—long strips of papyrus rolled around rods. They were all written by hand, for printing had not yet been invented.

A great lighthouse helped make Alexandria famous. It was one of the Seven Wonders of the Ancient World.

During the centuries Alexandria became a part of one empire after another. Its great library was destroyed by the city's conquerors. Its famous lighthouse fell during an earthquake. Mud washed into Alexandria's harbor and almost ruined it. By the end of the 18th century the city had lost much of its importance.

The story changed early in the 1800's. The harbor was dredged and a canal was dug to the Nile. Alexandria became a great port again. It is a great port today—a city of over 1,500,000 people. (See EGYPT; SEVEN WONDERS OF THE WORLD.)



ALFRED THE GREAT (849–899) One day, an old story goes, a man came to the door of a herdsman's hut in England. He asked if he might come in and rest. The herdsman's wife said that he might, and told him to watch the cakes she was baking. She went on an errand. His mind was so filled with other things that he let the cakes burn. The woman scolded the visitor, never guessing that he was her king.

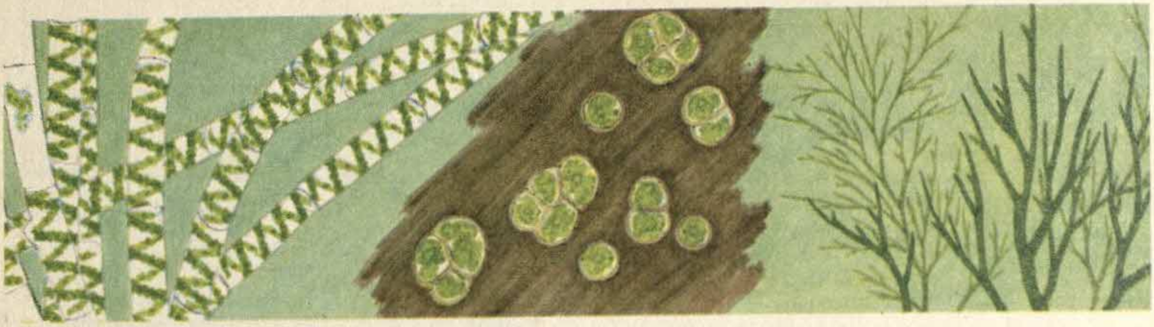
This is one of many stories told about the early king of England who is now known as Alfred the Great. The story probably is not true. But it might be. For Alfred for a time was in hiding.

Alfred became king at a very dark time in England's history. The Danes had won a foothold on Great Britain and threatened to conquer it all. Alfred was soon driven from London. He made his way to the big marshes of Somerset. On an island he began building an army. At last he fought a great battle with the Danes and won.

After the Danes were defeated, Alfred set about making his kingdom strong. London was almost ruined. He rebuilt it. He started a navy. He made the laws better.

Before Alfred's time few records were kept of what happened in England. In his reign the careful keeping of records began.

Alfred was much loved by his subjects. Probably no ruler in all history worked harder for his people. He is the only English king who is called "the Great." (See ANGLO-SAXONS.)



Freshwater Green Algae

ALGAE All the plants in the pictures on these two pages are algae. Algae are simple plants. They do not have roots or leaves or flowers or seeds. Some are very tiny. But some are very big.

The plants pictured here belong to four of the big groups of algae—the brown algae, the red algae, the green algae, and the blue-greens. A fifth group, the golden algae, includes the diatoms. All algae have in them the green dye called chlorophyll. They can make food for themselves, just as all green plants can.

The seashore is a good place to go to see algae, for seaweeds are algae. The largest of the seaweeds are brown algae. Some of them are as long as our tallest trees are tall. Holdfasts anchor these big seaweeds to rocks. Their stalks are often like ropes, and their blades may look like giant leaves. Brown algae are such tough plants that they can stand the beating of the waves along the shore.

Some brown algae are called kelps. From them we get jellylike materials that are useful in making things as different as automobile tires and ice cream.

Red algae, as a rule, are feathery. They are common in warm seas. Most of them grow where the water is quiet.

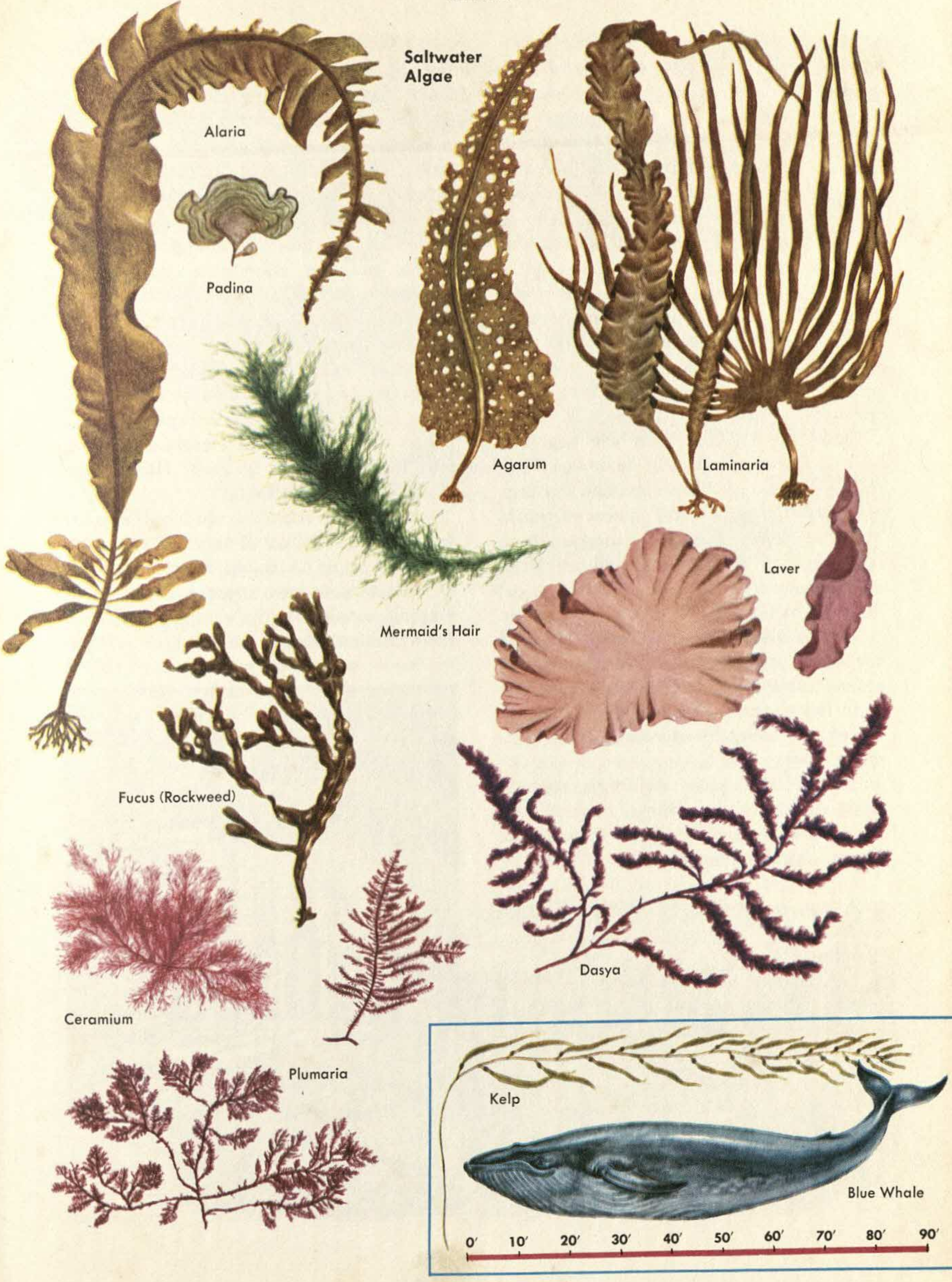
The pond scums of lakes, ponds, and streams are algae, too. Most of them are either green or blue-green algae. Some of them are made of only a single cell. These are so tiny that they cannot be seen without a microscope. Many green and blue-green algae, however, look like threads. Some of these threads are beautiful under a microscope. A few kinds of green and blue-green algae live in damp places on land.

Diatoms are found in both fresh and salt water and also in damp soil. These algae have tiny glassy cell walls like little pillboxes. Diatoms form a very important part of plankton, the "sea soup" on which many marine animals live.

Water may have so many algae in it that it is colored by them. The water in aquariums is often green because it contains so many algae. Algae color the water of some springs. They may even color snow red.

Some seaweeds are edible. The people of the Orient eat more of them than do the people of other regions. The Japanese, for instance, lower bundles of bamboo into the sea for algae to grow on. Now that the world population is "exploding," people will be thinking more and more about crops from the sea. There is far more sea than land on the earth. Many seaweeds are nourishing. Perhaps ways will be found of making them popular as food. One of the freshwater green algae is promising as a food for spacemen.

Algae have lived on the earth for hundreds of millions of years. The first living things, many scientists think, were tiny plants very much like the simplest of the blue-green algae of today. Scientists believe, too, that green algae of prehistoric ages were the ancestors of all the green plants that now grow on land. Algae are certainly so important that everyone should know about them. (See DIATOMS.)


Saltwater Algae
Alaria
Padina
Agarum
Laminaria
Mermaid's Hair
Laver
Fucus (Rockweed)
Dasya
Ceramium
Plumaria
Kelp
Blue Whale
0′
10′
20′
30′
40′
50′
60′
70′
80′
90′

ALHAMBRA A great fortress-palace crowns a hill overlooking the city of Granada, in southern Spain. It is called the Alhambra. The Alhambra was built by the Moors, who for centuries held most of the Spanish peninsula. Granada was the last stronghold of the Moors in Spain. The forces of King Ferdinand and Queen Isabella of Spain captured the Alhambra in 1492, the year Columbus made his famous voyage.

The name "Alhambra" means "the red." The building was given this name because of the red bricks used in building it.

The Alhambra is enormous; it covers 35 acres. Work on it began in 1248. It went on for more than 100 years.

Inside the building there are beautiful halls and courtyards and fountains. The walls are decorated with delicate carvings and inlays of silver and mother-of-pearl. There are many mosaics—pictures made of bits of colored stone. The Alhambra is the finest example of Moorish art to be found in all of Spain.

The Spanish conquerors badly damaged the Alhambra. Over the years fires and a violent earthquake also did great damage to it. But some of the damage has been repaired. The Alhambra now has much of its old splendor.

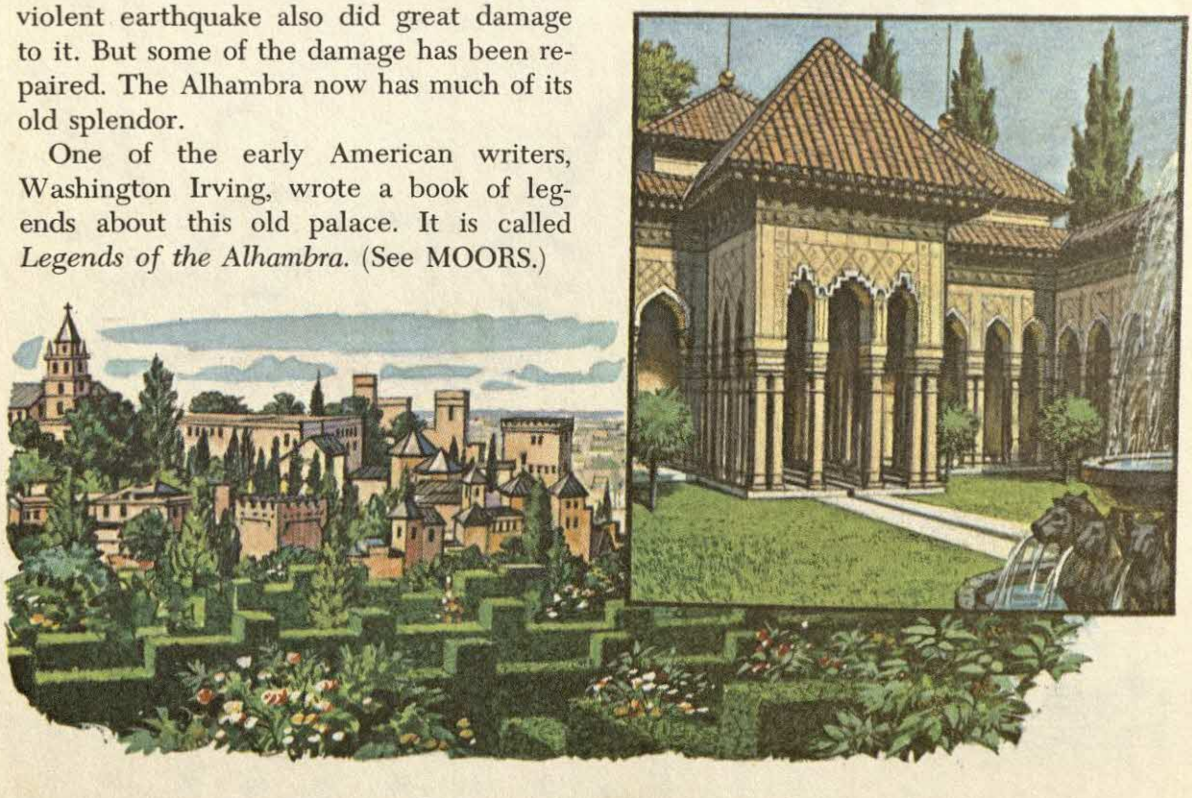
One of the early American writers, Washington Irving, wrote a book of legends about this old palace. It is called *Legends of the Alhambra.* (See MOORS.)

ALLERGIES Many people who like the taste of strawberries never eat them. They know that they are likely to become sick. These people are sensitive to strawberries. A sensitiveness of this kind is called an allergy. Different people are allergic to different foods. Wheat, milk, and eggs are three foods many people are allergic to.

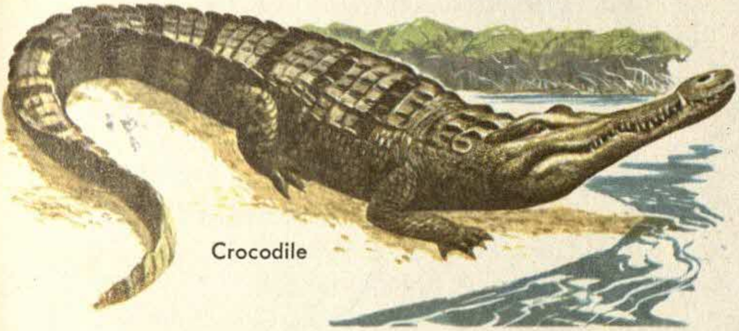
Not all allergies are allergies to food. People may be allergic to things they breathe in or touch. They may be allergic to such things as dust, pollen, fur, feathers, drugs, or dyes.

Hay fever, asthma, and hives are three common diseases due to allergies. Hay fever is caused by pollen, especially the pollen of ragweed. An attack of asthma may be brought on by dust. Hives, as a rule, are caused by foods.

A person can usually avoid foods he is allergic to. It is not at all easy to avoid such things as pollen, dust, and dyes. Fortunately, doctors now have found many ways of helping people who have allergies to live more comfortably.

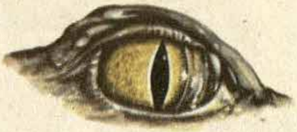


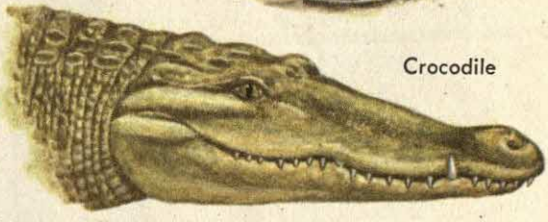
Alligator



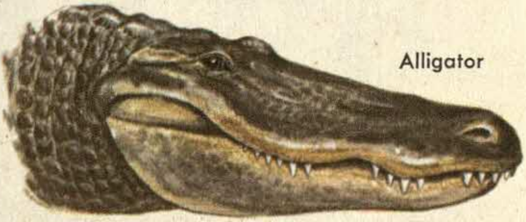
Crocodile

Eye of Crocodile





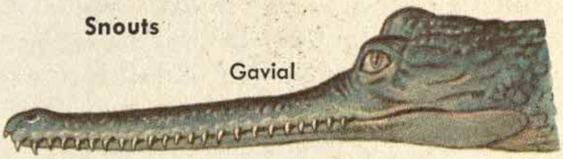
Crocodile



Alligator

Snouts

Gavial



ALLIGATORS AND CROCODILES Once there were reptiles much, much bigger than elephants. Today, so far as average size goes, the biggest reptiles are the alligators and crocodiles. The largest crocodiles are bigger than the largest alligators. Some are as much as 24 feet long. These big crocodiles are not the largest of all reptiles, however. The leatherback turtle is bulkier.

Alligators and crocodiles look much alike. But the shape of their heads helps in telling them apart. On each side of its mouth a crocodile has a long lower tooth which shows outside its upper teeth when its jaws are shut. A third member of this group, the gavial of India, can be told by its long, thin snout.

The reptiles of the group all spend most of their time in water, but they cannot breathe or swallow food underwater. They begin their lives on land. They hatch from eggs laid in a nest on land.

Like all their reptile relatives, alligators and crocodiles are cold-blooded. Their bodies are the temperature of their surroundings. They cannot stand cold weather. Most alligators and crocodiles live near the equator. The American alligator lives the farthest north. This reptile of our Gulf states often tells where it is by bellowing. It can be heard a mile away.

As anyone would guess from their sharp teeth, alligators and crocodiles are meat eaters. They eat fish. They also catch land animals that come down to the water's edge to drink. There are some fierce man-eating crocodiles. Long ago people had the idea that a crocodile shed tears when it ate a person. Now "shedding crocodile tears" means just pretending to be sad.

These reptiles are clumsy on land, but they are good swimmers. Often, however, they lie still in the water with only their eyes and nostrils above the surface.

Both alligators and crocodiles are covered with scales. On their backs the scales are hard and bony. On the rest of their bodies the scales are tough and leathery.

The skin of these reptiles is used for shoes, purses, belts, and luggage. In spite of laws passed to protect them, the American alligator and the American crocodile are in danger of disappearing.

ALLOYS Many of the metal articles in everyday use are made of brass. Brass bookends, brass candlesticks, and brass doorknobs are common. But no one has ever heard of brass mines. There are none. Brass is a mixture of two metals: copper and zinc. A mixture of this kind is called an alloy.

In the making of brass, copper and zinc are heated until they melt. Actually one metal dissolves in the other. When the mixture cools, it hardens. It does not look like a mixture. No one can see any bits of either copper or zinc.

There are many other alloys. In fact, almost none of the metal things we use are made of a single pure metal.

By far the most common alloy is steel. Steel is chiefly iron. Iron is not tough enough or strong enough for such things as bridges and skyscrapers and automobiles. But when it is combined with just the right amount of carbon, tough, strong steel is produced. Carbon is not a metal. An alloy, then, may be a metal mixed with something that is not a metal. Today there are many kinds of steel. Most kinds contain at least one metal besides iron. All stainless steel, for instance, contains both chromium and nickel. Some steel has as many metals in it as there are vegetables in an Irish stew.

Bronze is another common alloy. It is a mixture of copper and tin. We call our pennies copper, but actually they are made of bronze.

The alloy called pewter is mostly tin. Old-style pewter had lead in it. Now other metals are often used in place of lead.

Many people think that sterling silver is pure silver. But pure silver is too soft for knives and forks and spoons. Sterling silver is an alloy of silver and copper. Of course, it is mostly silver. German silver, or nickel silver, is not silver at all. It is an alloy of copper, nickel, and zinc.

American nickels are only one-fourth nickel. The rest is copper.

Pure gold, like pure silver, is soft. As a rule, alloys of gold are used instead. Yellow gold has copper in it. White gold contains a silvery metal, usually nickel.

Amalgams (uh MAL gums) are alloys that are part mercury. Dentists often use a silver amalgam for fillings.

Aluminum is much used in alloys partly because of its light weight. So is the less common metal magnesium.

Alloys have made the exploration of outer space and of the deep sea possible. Without them supersonic—faster-than-sound—planes could not be built. They play an important part in experiments with extreme cold. They are used in atomic power plants, where intense heat is a problem.

Nowadays, if an inventor cannot find a metal that suits his purpose, he tries to have a new alloy made that will. The search for new alloys is going on all the time. (See BRONZE; IRON AND STEEL; METALS.)

ALPHABET In a big dictionary of the English language there are thousands and thousands of words. All of them are written with just 26 separate letters. The 26 letters are the English alphabet.

We often call the 26 letters the ABC's. Calling them the alphabet instead is really calling them the AB's, for the word "alphabet" comes from the Greek names for these two letters. *Alpha* is the Greek name for *A*. *Beta* is the Greek name for *B*.

People learned to write long before they had an alphabet. Different peoples had different ways of writing. But in all the early ways there were a great many different signs. Both the Egyptians and the Babylonians, for instance, used hundreds of different signs. These signs were not letters. They—at least most of them—did not stand for simple sounds as letters do.

The alphabet was certainly a wonderful invention. But who invented it?

It is easy to trace the alphabet back to the ancient Romans and from them to the Greeks. From the Greeks we can trace it still farther back to the Phoenicians. From there on the story is not yet clear. Scholars are still trying to unravel the early history of the alphabet.

The Phoenicians were the great traders of ancient times. They belonged to the group of peoples called Semites.

Semites filled the whole region along the eastern shores of the Mediterranean some 3,500 years ago, when the alphabet had its beginnings. The birthplace of the alphabet may have been almost anywhere in that region. We shall call the inventors of the alphabet simply the Semites.

The alphabet probably started in this way: Some of the Semites had business dealings with the Egyptians. They watched Egyptian scribes keeping written records. They saw that Egyptian writing was complicated. Some of the hundreds of signs the Egyptians used stood for whole ideas; some stood for whole words; some stood for syllables made up of several sounds; and a few (24 of them) stood for simple sounds. The Semites hit upon the idea of a much easier way of writing. They would use *only* signs for simple sounds. The alphabet began with this idea.

The Semites found that they could write their language by using less than 30 signs, or letters. Some, or even all, of the signs the Semites worked out were pictures in the beginning. Their sign that became our *M* was first the picture of water (〰); their

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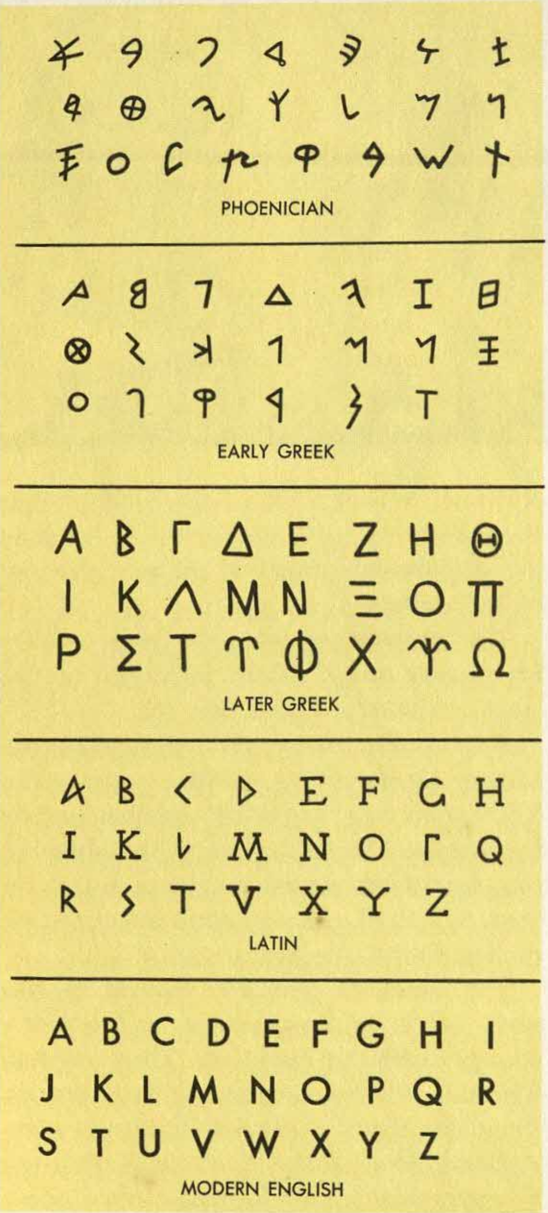
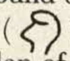
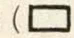
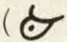


word for water began with the sound of *M*. In the same way, their sign for the sound of *R* was first the picture of a head (); their sign for the sound of *B* was a plan of a house (); and their sign that became our *A* started as the picture of an ox (). Whether they were all pictures in the beginning or not, the letters in the Phoenician alphabet the Greeks borrowed did not look like pictures of anything.

In the English alphabet there are several vowels. In the Phoenician alphabet there were none. Without vowels, "Jack and Jill" would be written this way:

Jck nd Jll wnt p th hll
T ftch pl f wtr.
Jck fll dwn nd brk hs crwn
Nd Jll cm tmblng ftr.

The Greek language did not have in it some of the sounds in the Phoenician language. The Greeks did not need signs for those sounds in their alphabet. But they found that they could not write their language well without vowel signs. Some of the Phoenician letters they did not need they therefore used for vowels.

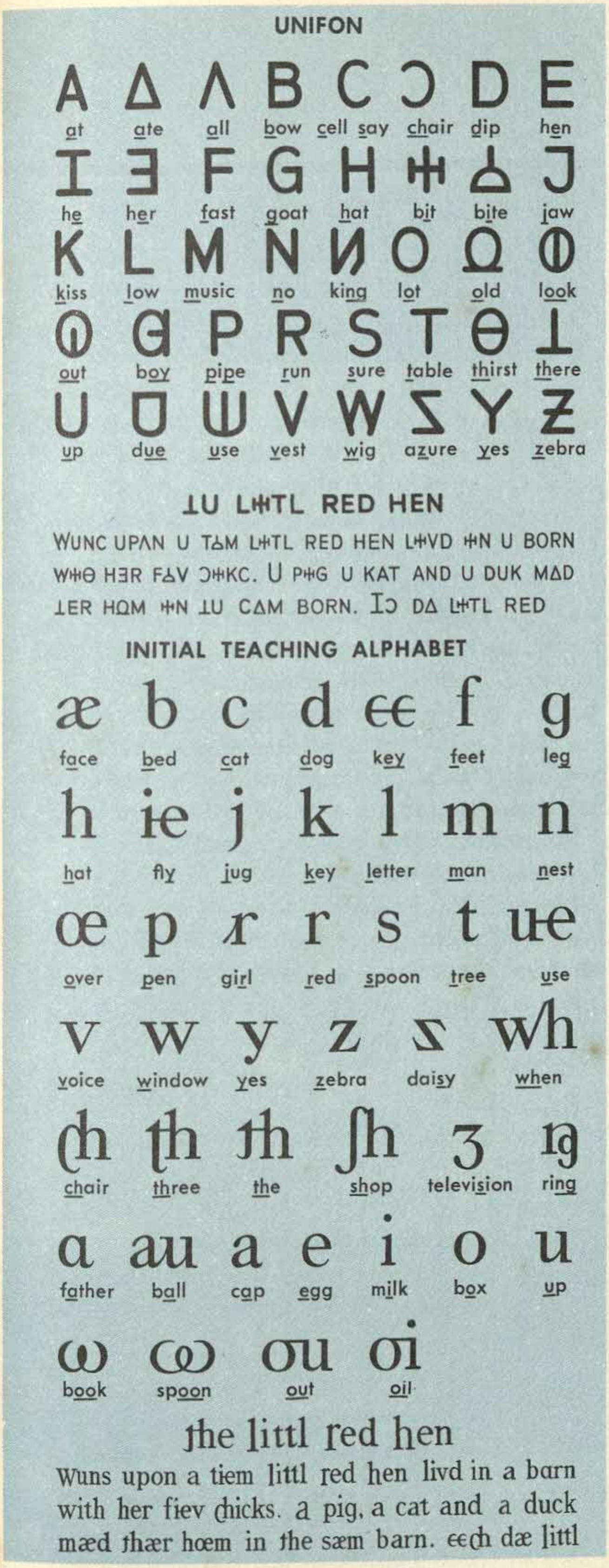
As the Greeks used their alphabet, they gradually changed some of the letters. They added some new ones, too.

The Romans, when the alphabet came to them from the Greeks, made the same kinds of changes the Greeks had made. They changed the shapes of some of the letters. They gave up a few of the letters they did not need for writing their language, Latin. And they added one or two of their own.

The alphabet came down to us from the Romans with little change. After printing was invented, *U* and *V*, which had been two ways of writing the same letter, became two separate letters. So did *I* and *J*. But most of the English letters are the same as those the Romans were using 2,000 years ago.

Although all the words in English are written with 26 letters, they are made up of more than 26 single sounds. Some of the letters stand for several different sounds. No wonder spelling is not easy.

Most languages are written with alphabets much like ours—alphabets made from the one invented by the Semites long ago. A few languages are still written with signs that are not letters. Chinese writing, for instance, is done with such signs. But writing with an alphabet is much more common. The world owes a great deal to the people of long ago who first wrote with letters. (See Letters A through Z; WRITING.)

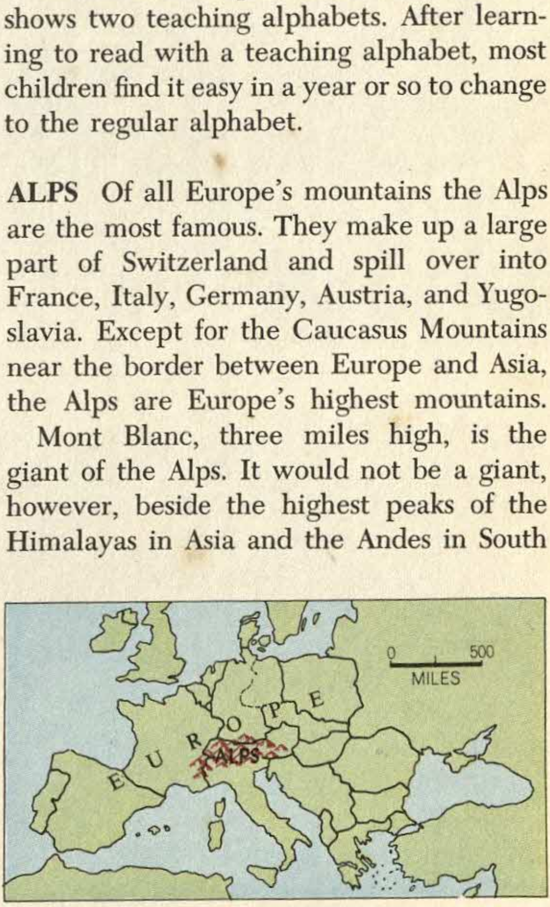


ALPHABETS, TEACHING Some children find it hard to learn to read. One reason is that some letters or groups of letters do not always have the same sound. The "o" in "to," for instance, does not have the same sound as the "o" in "no." And "cough," "bough," "rough, " "dough," and "through" do not rhyme although they all end in "ough." Besides, one letter or group of letters may have exactly the same sound as another letter or group of letters. What beginning reader would guess that "I" and "eye" sound exactly alike?

To make reading easier for beginners, teaching alphabets are now being used in many schools. Each sign in a teaching alphabet stands for only one sound. And no two signs have the same sound. There are, you know, 26 letters in the English alphabet. There must be more signs in a teaching alphabet since English words are made up of more than 26 separate sounds. The chart shows two teaching alphabets. After learning to read with a teaching alphabet, most children find it easy in a year or so to change to the regular alphabet.

ALPS Of all Europe's mountains the Alps are the most famous. They make up a large part of Switzerland and spill over into France, Italy, Germany, Austria, and Yugoslavia. Except for the Caucasus Mountains near the border between Europe and Asia, the Alps are Europe's highest mountains.

Mont Blanc, three miles high, is the giant of the Alps. It would not be a giant, however, beside the highest peaks of the Himalayas in Asia and the Andes in South

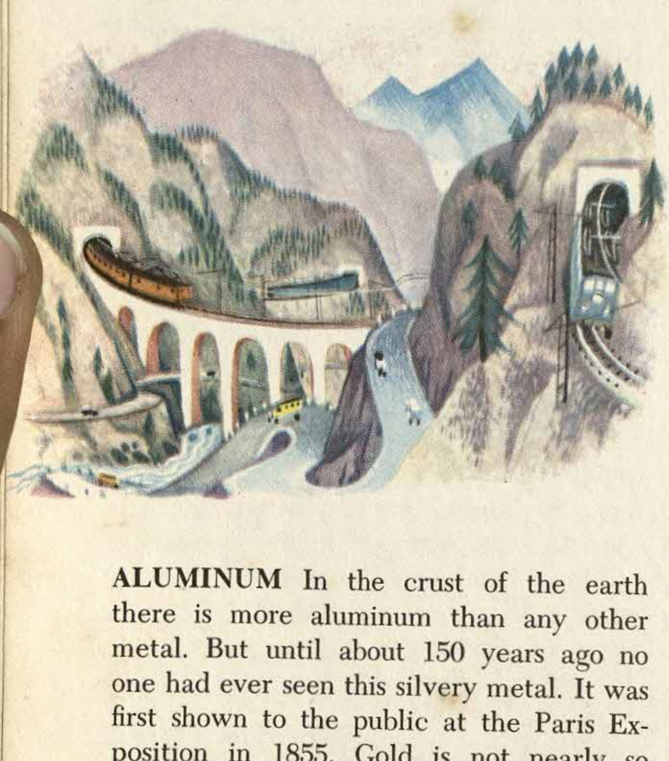


America. The top of Mont Blanc is always covered with snow. The mountain's name is French for "white mountain." Two other noted peaks in the Alps are the Jungfrau (YOONG frow) and the Matterhorn.

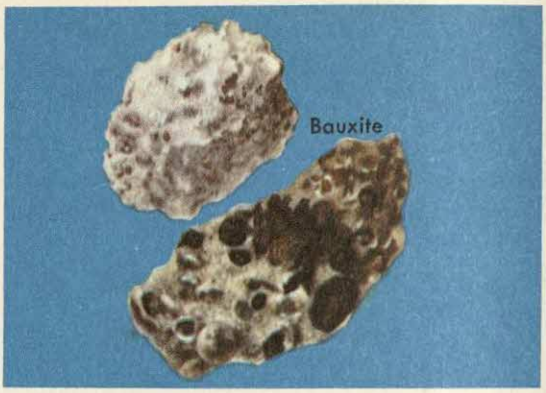
In 1965 a new seven-mile tunnel under Mont Blanc was opened to traffic. It is the longest automobile tunnel in the world.

The scenery in the Alps is beautiful. In many of the valleys there are glaciers—rivers of ice. There are snowfields all year round on many of the mountaintops. There are beautiful lakes and waterfalls. In all Europe there is no better place for skating and skiing and mountain climbing.

The Alps are young as mountains go. They are only about ten million years old!



ALUMINUM In the crust of the earth there is more aluminum than any other metal. But until about 150 years ago no one had ever seen this silvery metal. It was first shown to the public at the Paris Exposition in 1855. Gold is not nearly so common, but it has been used for thousands of years. The aluminum in the earth is very well hidden, because it is always joined with other materials. It is never found free. Gold and some other metals are.

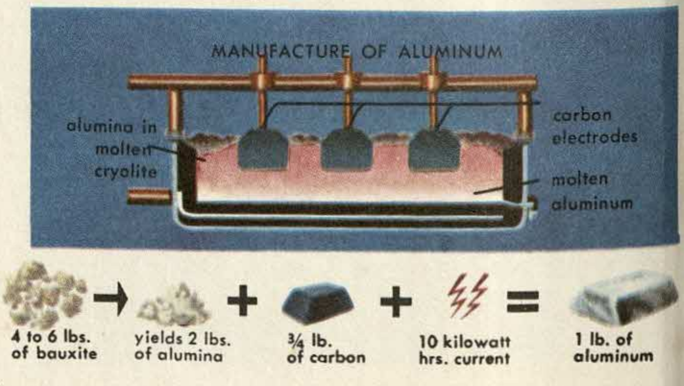


All clay has aluminum in it. So do many common rocks. But scientists had great trouble finding a way of making this metal come out of its hiding places. When they did, the way was very expensive. In 1852 aluminum cost more than $500 a pound. The price soon went down, but for years aluminum cost too much for common use.

Then, in 1886, an American college student, Charles Hall, found an easy way to get aluminum by using electricity. A French scientist, Paul Héroult, discovered the same process in the same year. By the end of World War II the United States alone, with the help of new power plants, was producing about a million tons of aluminum a year at a cost of 15 cents a pound!

Most aluminum now comes from the mineral bauxite. The United States and Canada produce more than half of all the aluminum produced in the world. Most of the bauxite needed must be brought in from other countries. Much of it comes from Surinam.

Aluminum ore is crushed treated with chemicals, and put into a special electric furnace. An electric current makes pure aluminum go to the bottom. It is then drained off.



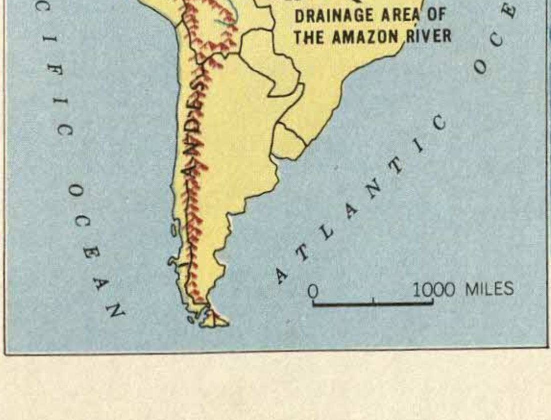
Today aluminum is used in many ways. A great deal of it goes into airplanes, locomotives, railroad cars, trucks, and boats. A submarine, the "Aluminaut," built to study the ocean floor, got its name from the aluminum in it. Keys, wire, foil, cooking pans, and tubes for toothpaste call for aluminum. Builders use huge amounts for walls, roofs, and window frames.

For most purposes alloys of aluminum, not the pure metal, are used. Small amounts of other metals, that is, are mixed with it.

Aluminum is a useful metal partly because it is both light in weight and strong. Besides, it does not rust, and it can be made into any shape that is wanted. (See ALLOYS; ELEMENTS; METALS.)

AMAZON RIVER The world's mightiest river, the Amazon, rises in the Andes Mountains in South America. As it journeys nearly 4,000 miles to the Atlantic Ocean, more than 200 streams join it. The Amazon has more water than the Mississippi, the Nile, and the Yangtze rivers combined.

The Mississippi-Missouri and the Nile are both about the same length as the Amazon, but they do not match it in size. At many places the Amazon is too wide to see across. It has been called a moving inland sea. At its mouth the great river is 150 miles wide and 200 feet deep.



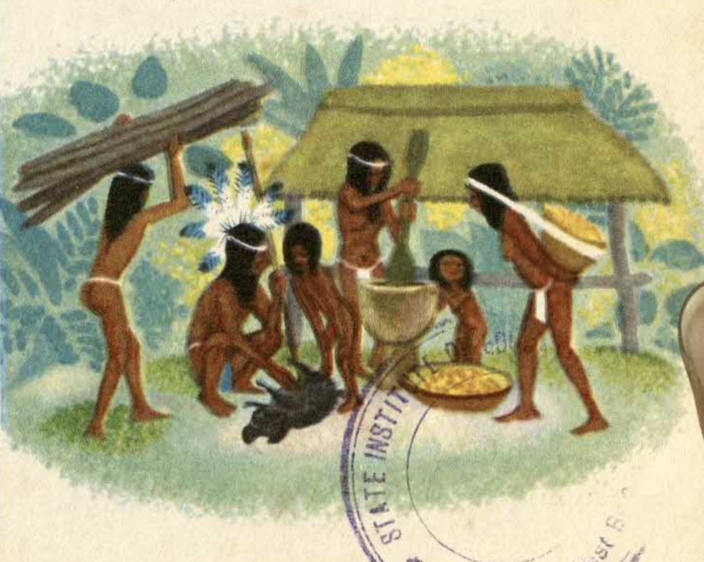
For all its size, the Amazon is sluggish. After it leaves the mountains, it flows through flat land not very high above sea level. The river drops only 135 feet in its last thousand miles to the sea.

Traveling up the Amazon is very different from traveling up the Nile or Mississippi. The region through which the Amazon flows is hot and wet all the year round. For hundreds and hundreds of miles dense forest grows down to the edge of the river.

The few cities on the river are hundreds of miles apart. Most of the other settlements are only small villages. Travel between the cities and villages is mostly by boat. There are very few roads through the tangled forests.

The Amazon is famous for its alligators, more accurately called caimans. As boats go by, many "logs" lying on the bank slide off and dive under the water.

The muddy water of the Amazon can be seen far out into the ocean. Once a sailing ship ran out of drinking water in the Atlantic about 50 miles from the mouth of the river. The captain begged for water from a passing ship. "Dip it out of the ocean," he was told. He did, and the water was not salty. It was water from the Amazon that had not yet mixed with the salty water of the sea. (See RIVERS.)



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AMAZONS Among the old Greek legends there are stories of women warriors called Amazons. The Amazons, the stories say, lived in a country where the only men were slaves captured in battle. Even their ruler was a woman. Whenever a son was born to an Amazon, he was killed or sent out of the country. The daughters were kept, and as they grew up they were taught to hunt and farm and fight. The Amazons did most of their fighting on horseback. They were very strong and brave.

The Amazon River was named for these legendary women warriors. A Spanish explorer gave the river its name because, he said, he had to fight Indian women warriors as he traveled along it.

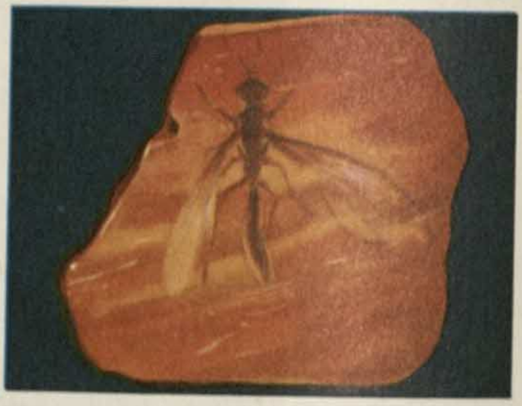
AMBER Christmas trees are often sticky to the touch. They produce a sticky gum, or resin, as they grow. Many of the evergreen trees that lived millions of years ago produced resin, too. Some of these trees fell into swamps and were covered with mud. The resin on them gradually changed as they lay buried century after century. It changed to the material we call amber. Amber, then, is fossil resin.

In some amber there are fossil insects. The insects were trapped in the resin millions of years ago.

In the days of the ancient Greeks no one knew what amber was. Pieces of amber, a Greek myth said, were tears shed by the sisters of Phaëthon (FAY a thon). Phaëthon drove the chariot of the sun too close to the earth. To keep the earth from burning up, the king of the gods killed Phaëthon with a thunderbolt.

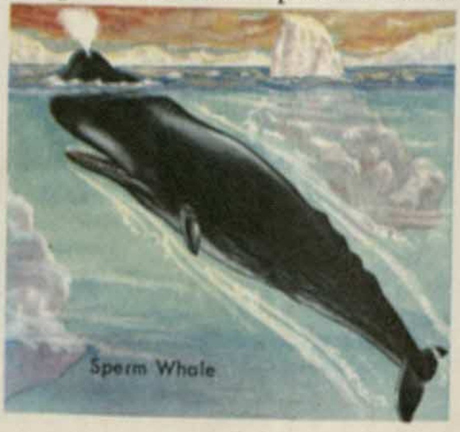
The word "electricity" comes from the Greek word for amber. More than 2,000 years ago the Greeks found that a piece of amber rubbed with fur would pick up tiny bits of straw. The amber, scientists found out later, was given a charge of electricity by the rubbing.

Amber makes beautiful beads. It is used also for the stems of pipes. (See FOSSILS.)



Insect Fossil in Amber

AMBERGRIS (AM bur grees) Not many people would guess that whales have anything to do with perfume. But they have! A sperm whale sometimes produces in its intestines a waxy material called ambergris. "Ambergris" means "gray amber." This material is a sign of an intestinal disease. Ambergris is used in fine perfumes. It helps



keep the flower oils used in perfumes from losing their odor. It even makes the odor stronger.

Lumps of ambergris are sometimes found floating on the surface of the ocean. Much of the ambergris we get, however, comes from whales that are caught and killed for their oil.

Ambergris sells for a high price. The men on a whaling vessel may make more from ambergris they find in a whale than from all the oil in the great animal. Just a single lump once sold for $28,000.

AMBROSIA The ancient Greeks and Romans worshiped many gods and goddesses. Their gods and goddesses, the Greeks and Romans thought, were very much like people except that they never grew old and died. They were kept from growing old by their wonderful food. This food was called ambrosia. Each day the needed ambrosia was brought to the king of the gods by pigeons.

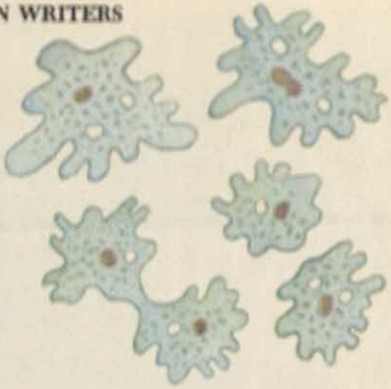
Today saying that anything is food for the gods or that it tastes like ambrosia is the same as saying that it has a far, far better taste than plain everyday food.

AMEBA The ameba belongs to the group of one-celled animals called protozoa. The protozoa are so much simpler than other animals that many scientists put them in a kingdom of living things called protists.

Amebas are found in damp ground and stagnant water in almost all parts of the world. They may even be found inside the bodies of other animals.

An ameba's one-celled body looks much like a bit of colorless jelly. But it carries on many of the kinds of work the bodies of larger animals carry on. It takes in food, digests it, and throws away the waste. It also breathes, moves about, and produces more one-celled animals like itself.

This tiny organism reproduces in an easy way. It simply divides into two. Each half is soon full grown.



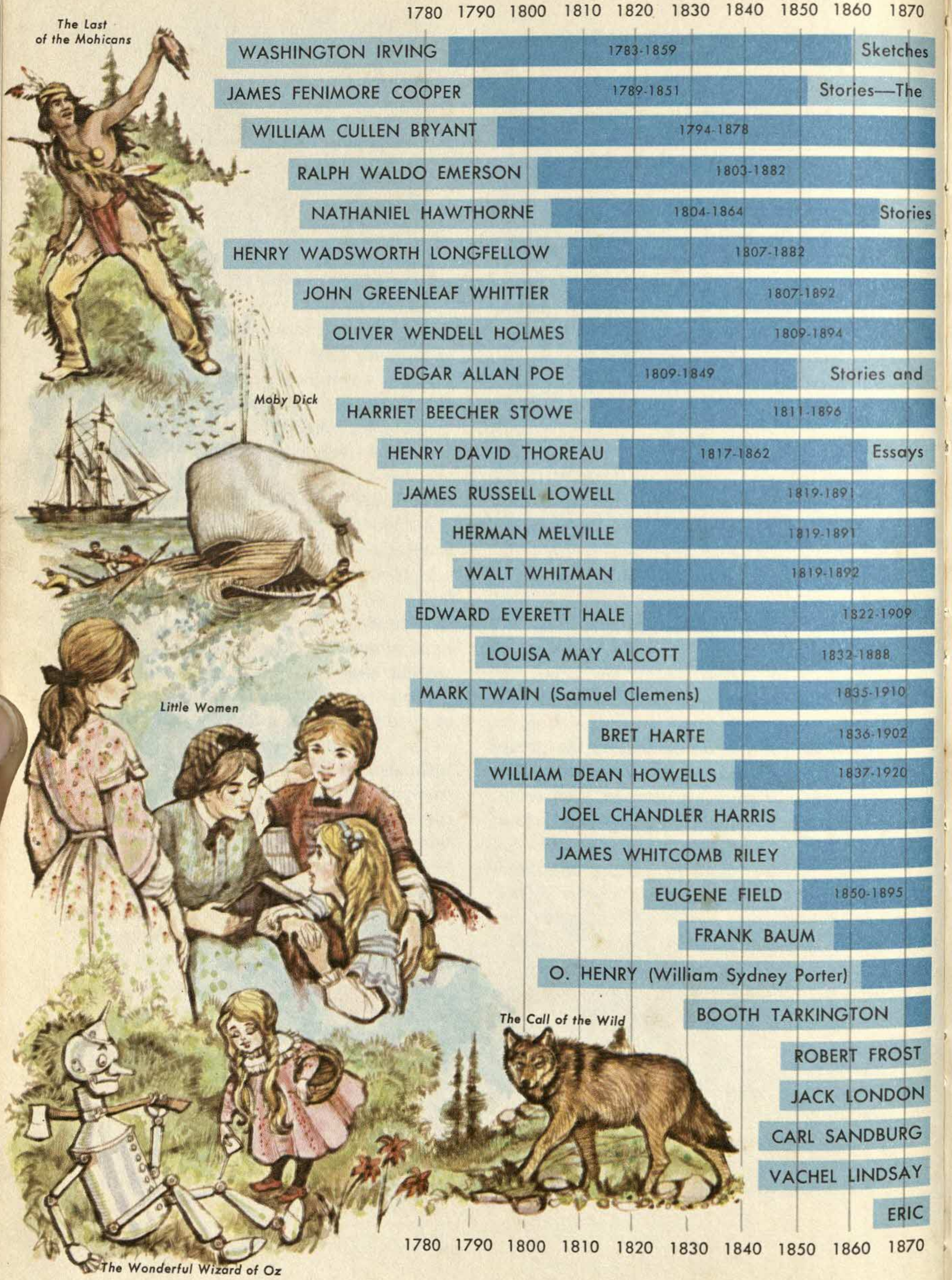
How an Ameba Divides into Two

An ameba moves very slowly. A part of its body pushes forward and pulls the rest of the body after it. To eat, an ameba simply moves a part of its body around a particle of food. As it pushes out one "arm" after another, the little animal keeps changing shape. (See PROTISTS; PROTOZOA.)

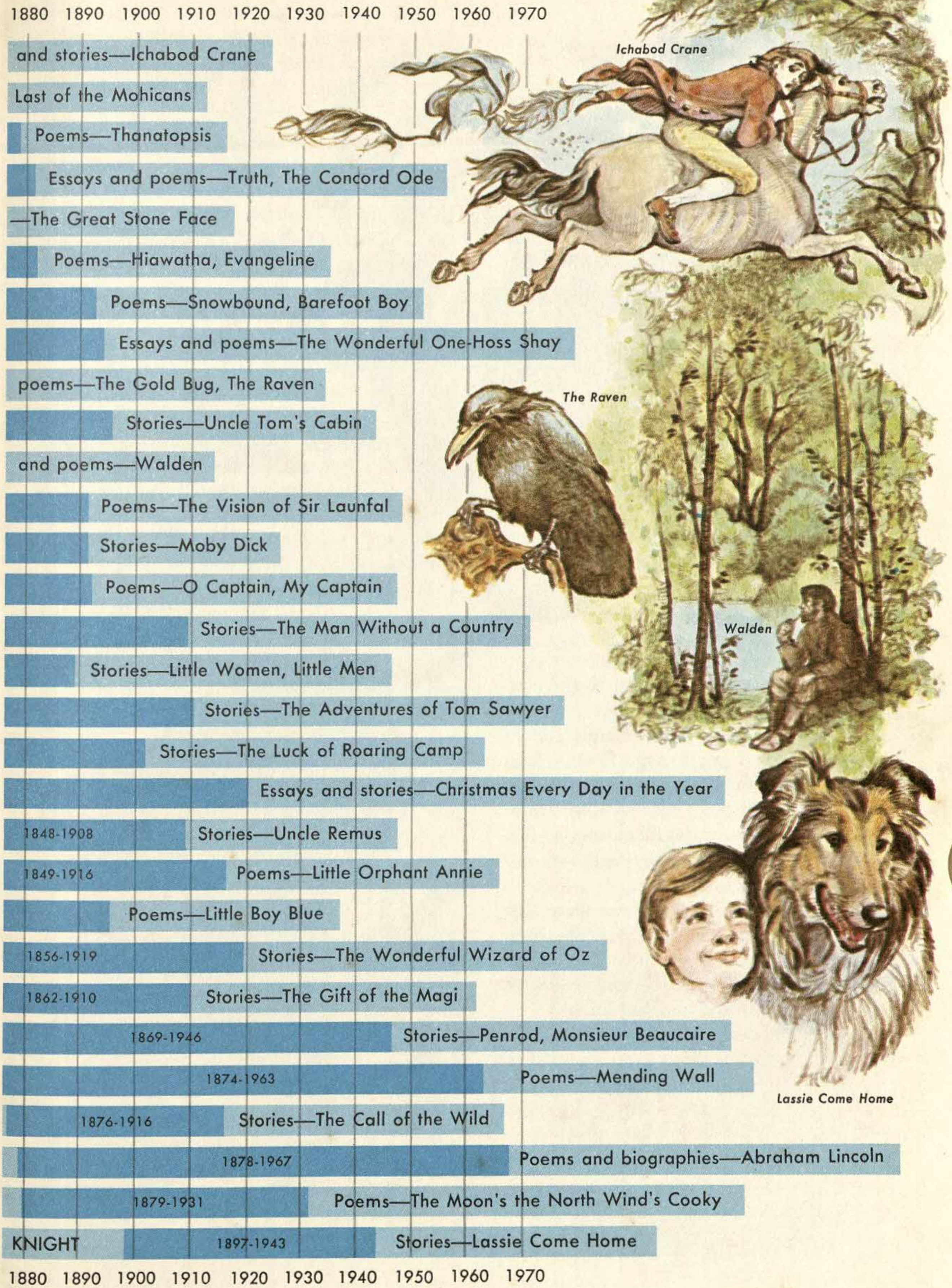
AMERICAN WRITERS A young country is not likely to have many writers, just as it is not likely to have many great painters or sculptors. Before 1800 Americans were too busy building a new nation to have much time to write. But from then on there have been many American writers. They have written plays and essays and stories and poems. Some of what they have written is so good that it is sure to last.

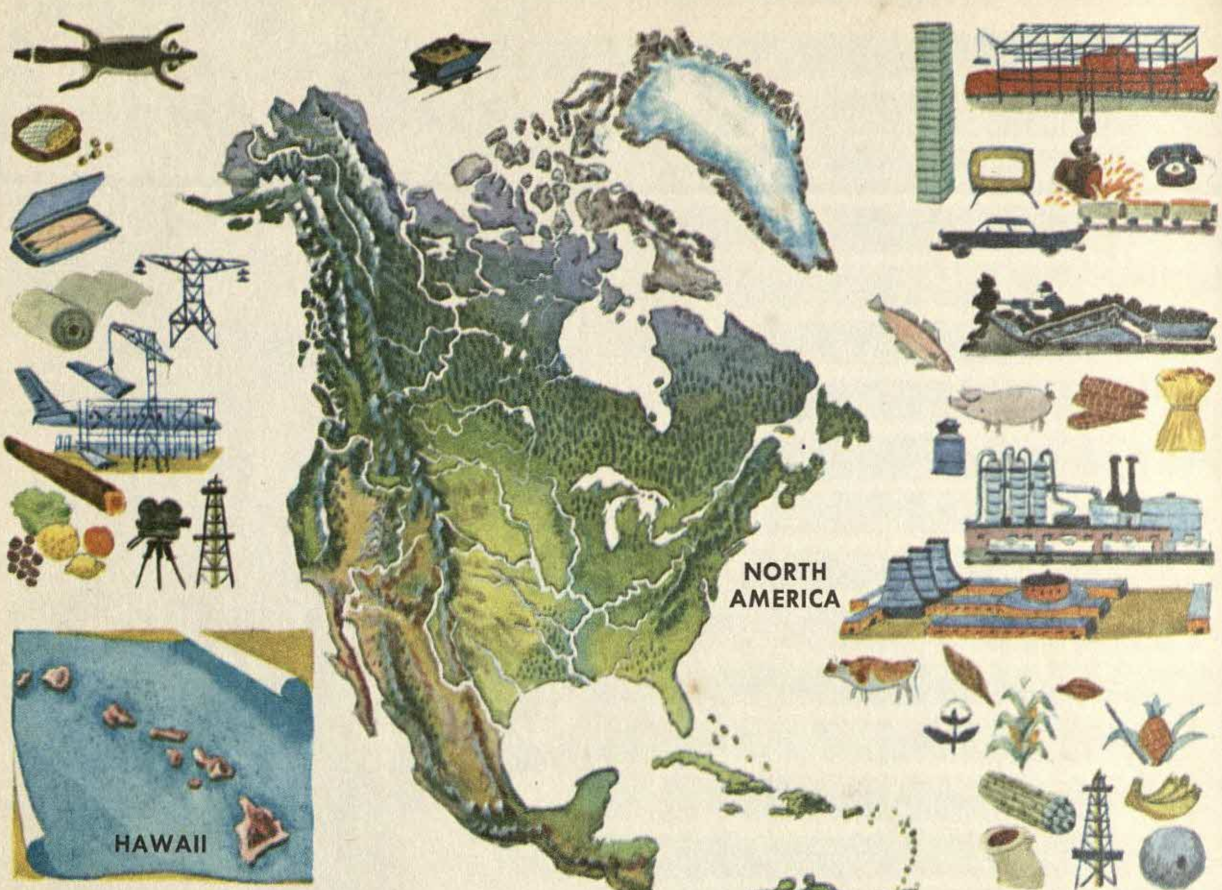
The chart on the next two pages tells a little about a few American writers. It tells when they lived and what kinds of things they wrote. It gives the names of one or two of their books or poems or stories. Washington Irving, the first author listed in the chart, is often called the father of American literature.

Most of the authors in this list have written poems or stories that children enjoy. Some of the characters they wrote about we know as well as we know the people who live next door. There are Little Orphant Annie, Little Boy Blue, and Meg, Jo, Beth, and Amy. There are Tom Sawyer, Huckleberry Finn, and Penrod. There are Uncle Remus and Rip van Winkle and the Wizard of Oz. There are many others, too. All of them are well worth knowing.


1780 1790 1800 1810 1820 1830 1840 1850 1860 1870
The Last of the Mohicans
WASHINGTON IRVING 1783-1859 Sketches
JAMES FENIMORE COOPER 1789-1851 Stories—The
WILLIAM CULLEN BRYANT 1794-1878
RALPH WALDO EMERSON 1803-1882
NATHANIEL HAWTHORNE 1804-1864 Stories
HENRY WADSWORTH LONGFELLOW 1807-1882
JOHN GREENLEAF WHITTIER 1807-1892
OLIVER WENDELL HOLMES 1809-1894
EDGAR ALLAN POE 1809-1849 Stories and
Moby Dick
HARRIET BEECHER STOWE 1811-1896
HENRY DAVID THOREAU 1817-1862 Essays
JAMES RUSSELL LOWELL 1819-1891
HERMAN MELVILLE 1819-1891
WALT WHITMAN 1819-1892
EDWARD EVERETT HALE 1822-1909
LOUISA MAY ALCOTT 1832-1888
Little Women
MARK TWAIN (Samuel Clemens) 1835-1910
BRET HARTE 1836-1902
WILLIAM DEAN HOWELLS 1837-1920
JOEL CHANDLER HARRIS
JAMES WHITCOMB RILEY
EUGENE FIELD 1850-1895
FRANK BAUM
O. HENRY (William Sydney Porter)
The Call of the Wild
BOOTH TARKINGTON
ROBERT FROST
JACK LONDON
CARL SANDBURG
VACHEL LINDSAY
ERIC
1780 1790 1800 1810 1820 1830 1840 1850 1860 1870
The Wonderful Wizard of Oz

AMERICAN WRITERS

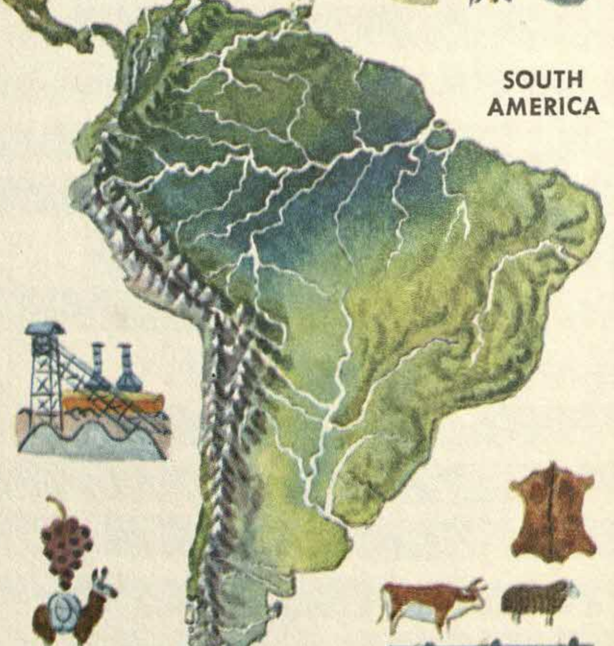




AMERICAS It is easy to turn a globe so that only two continents show—North America and South America. The Atlantic Ocean separates them from Europe. This ocean is so wide that for centuries no one in Europe guessed that the Americas were there. The same ocean separates them from Africa. An even bigger ocean—the Pacific—is between the Americas and Asia.

When, in time, the Americas were discovered, Europeans called them the New World. The countries in these two continents are all young countries compared with such countries as England and Spain.

No one, however, should get the idea that the Americas had no people until Europeans first reached their shores. There were Indians living in both North and South America. Some of them were highly civilized. Their ancestors had come into North America thousands of years before. There were times when a land bridge reached from



North America to Asia. It stretched westward from Alaska. It would have been possible then for people to cross from one continent to the other.

One name for half of a globe is "hemisphere." The Americas are in the earth's Western Hemisphere. They stretch nearly 9,500 miles from north to south. The Isthmus of Panama joins them together.

All of North America is north of the equator. Most of South America is south of it. Most of South America, therefore, has winter when North America is having summer, and the other way round.

Many people think of South America as straight south of North America. It is not. South America is much farther to the east. The Isthmus of Panama goes almost east and west. The city farthest west in South America is Talara in Peru. This city is straight south of Cleveland. If a person traveled straight south from New Orleans or Denver or San Francisco, he would not reach South America at all.

Three countries—Canada, the United States, and Mexico—take up most of North America. South of Mexico in North America there are seven small countries, all but one independent. Together they make up Central America. South America is divided into 13 countries, all but two independent.

"Latin America" is a name one often hears. Latin America is the part of the Americas where Spanish or Portuguese is spoken. Spanish and Portuguese both come from the old Latin language. Latin America is made up of Mexico, the countries of Central America and South America, and most of the islands between the two continents. Of course, English is the language of the United States. It is also the language of much of Canada. Many people of eastern Canada speak French instead.

Language differences do not keep the countries of the Americas from joining one another for many purposes. The Pan-American games, for instance, bring athletes together from all over the Americas.

AMERICUS VESPUCIUS (1451–1512) In the years just before Columbus discovered America, Lorenzo the Magnificent was the ruler of the city of Florence in Italy. In Lorenzo's court there were many famous people. There were great artists and poets. There were great scholars, too. And one of the young men in the court was to give his name to nearly half the world. But this no one guessed. He was Amerigo Vespucci. In Latin his name is Americus Vespucius.

There has been much argument as to whether Vespucius deserved to have two great continents named for him. He sailed on two, perhaps more, expeditions to the New World. From Florence he had gone to Spain to work at the business of outfitting ships. He met Columbus as he helped outfit the ships Columbus used on his third voyage. Before Columbus sailed on his fourth voyage, Vespucius had become an explorer. He was an expert navigator; on one trip he sailed for thousands of miles along the coast of South America. On this trip he came to realize that both he and Columbus had reached, not the Far East, but a new world.

In 1507 a German map maker made a map of the New World. He wanted a name for the lands that had been discovered. He had heard of the voyages of Americus Vespucius and decided to make a name from his. He wrote "America" on the map. On a later map he used another name. But other map makers had seen "America" and liked it. The continents became the Americas. (See COLUMBUS, CHRISTOPHER; EXPLORERS.)

AMPHIBIANS There are five big groups of animals that have backbones. The amphibians are one of them.

Most baby amphibians live in water and are much like baby fish. They breathe with gills. With their big tails they can swim well. When they are grown up, most amphibians are more like reptiles. They breathe with lungs and live on land. The name "amphibian" means "double life." It is a good name for this group of animals.

Although most amphibians live on land for part of their lives, only a very few of them are able to stand extreme dryness. As a rule, amphibians must stay close to water or moist places. They have no protecting scales or fur or feathers.

The part of its life an amphibian spends in water is spent in fresh water. There are no amphibians in the sea.

There have been amphibians on the earth for many millions of years. Scientists say that the very first animals with backbones ever to live on land were amphibians. Amphibians were probably the first animals with voices.

Today there are about 2,000 kinds of amphibians. As you see, the tree of today's amphibians has three main branches: the toads and frogs, the salamanders, and the caecilians.

Toads and frogs are well known to almost everyone. Many people have watched toad or frog eggs hatch into tadpoles that change step by step into adults. It is no wonder that toads and frogs are well known. As the map shows, they are spread far and wide over all the continents. Toads and frogs have no tails when they grow up. The tailed frogs do not have true tails.

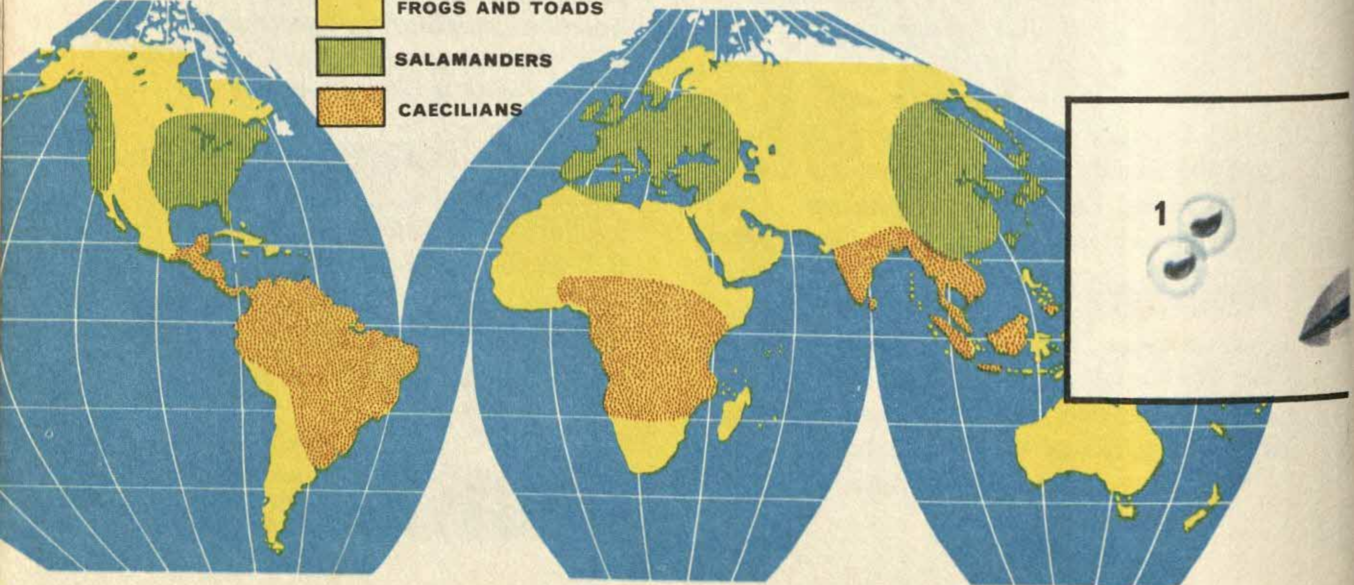
Salamanders have both legs and tails when full grown. Although they are fairly common in the parts of the world where they live, they are not very well known. For one thing they live in out-of-the-way places—often under the rubbish on forest floors or in caves. They do not attract attention by singing or croaking as toads and frogs do.

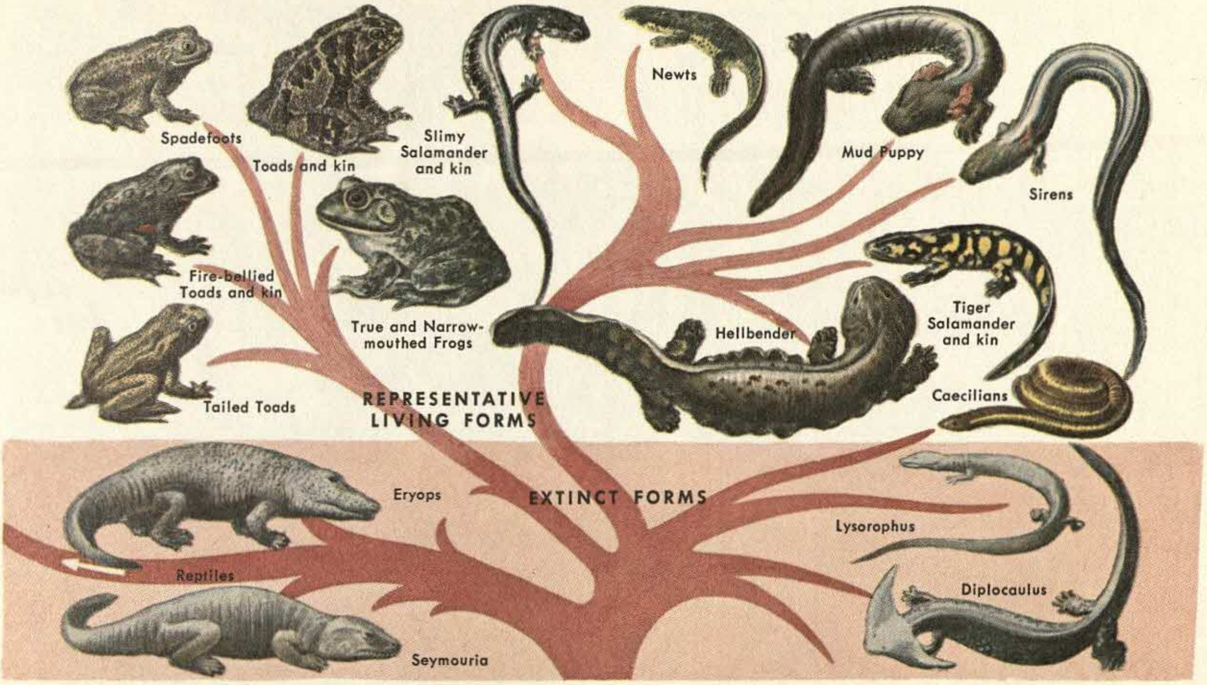
Caecilians (see SIL i ans) are not well known. They are found chiefly in warm regions. They have no legs and practically no tail. In fact, they look much like overgrown earthworms.

Amphibians vary greatly in size. They range from frogs half an inch long to the five-foot giant salamander of Japan.

Amphibians are cold-blooded. Those that live where the winters are cold hibernate. They bury themselves in damp ground or in mud at the bottom of a pond. During their winter sleep they live on food stored in their bodies and take in water and oxygen through their skin.

Amphibians cannot sting or bite or scratch. They protect themselves mostly by



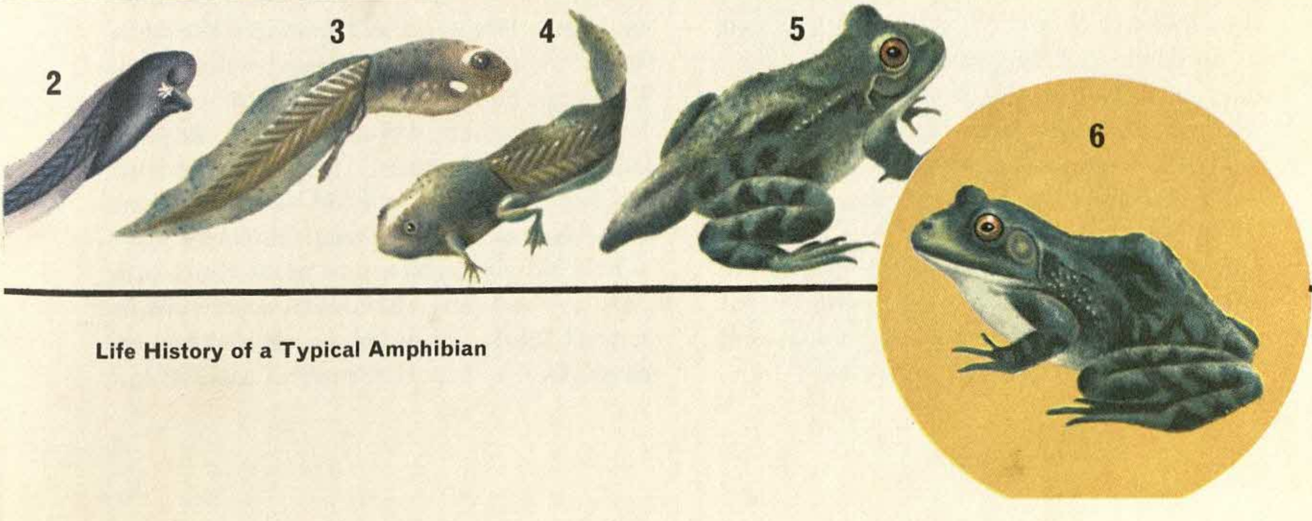


hiding from their enemies. A few have poison glands in their skin.

Not all amphibians lead double lives. The mud puppy, for instance, spends its whole life in water and always breathes with gills. A few amphibians spend their whole lives on land. A very few of these are live-bearing.

In the mountain lakes of Mexico and western United States the tiger salamander usually keeps its larva form all its life. In fact, it was given the name "axolotl" (AK so lot uhl) before anyone discovered that it was really the tiger salamander. The name "axolotl" comes from an ancient Aztec word. The Mexicans prize the axolotl as a food delicacy.

There are queer superstitions about some amphibians. One is that salamanders can stay in a fire without being harmed. Really salamanders do not stand heat well at all. Another superstition is that handling toads causes warts. Toads are rather warty themselves, but their warts are not like those people sometimes have. It is hard to understand how such superstitions start or why anyone believes them. (See FISHES; TOADS AND FROGS.)



Life History of a Typical Amphibian

AMUNDSEN (AH mun sen), **ROALD** (1872–1928) When he was still a boy in Norway, Roald Amundsen determined to be the first man to reach the North Pole. In 1909, after several years of sailing with other explorers, Amundsen was about ready to lead his own expedition to find the Pole. Then came word that Robert E. Peary had reached it. Amundsen changed his plans at once—he would find the South Pole.

It is much, much farther from Norway to the South Pole than from Norway to the North Pole. To reach the South Pole Amundsen would have to cross the hot regions near the equator. The heat would be especially hard on his Eskimo dogs.

He and his men set sail in the summer of 1910 on the "Fram." By New Year's Day they had sailed safely past the equator and so far south that they saw an iceberg. Two days later there were icebergs in every direction. Soon they saw ahead of them the wall of ice now called the Ross Ice Shelf.

By the middle of January Amundsen had made his way to a shore where he could land. There was now not time to get to the Pole and back before the long winter night began. The party built a winter house with lumber they had brought with them.

Amundsen's Camp Near the South Pole

In October, winter was over and the days were longer. On the 20th Amundsen set out for the Pole with four men and 52 dogs. He had food and fuel for four months.

For many miles the journey over the ice was rather easy. But then the party came to high mountains. Traveling through them was hard. Beyond the mountains the men found a great plateau two miles high. There the going was better again.

On December 14 Amundsen reached the South Pole and planted the flag of Norway. It was less than three years after the American flag was set flying over the North Pole.

In 1926 Amundsen flew over the North Pole in a dirigible. Two years afterward he lost his life in trying to rescue another explorer in the Arctic. (See ANTARCTICA.)

ANATOMY The doctors of today have a far better chance of making sick people well again than the doctors of the Middle Ages had. One reason is that today's doctors know much more about how people's bodies are built. Until the 1600's, for instance, no one knew how the blood vessels carry blood from the heart over the body and back again. The study of how living things are built is called anatomy.

Comparative anatomy is one branch of this science. Scientists find out how different kinds of living things are alike in the way they are built and how they differ.

ANDERSEN, HANS CHRISTIAN (1805–1875) For over a hundred years boys and girls have read and liked the fairy tales of Hans Christian Andersen. One of the fairy tales is "The Ugly Duckling." In a way this story is a story of the author's own life.

Hans was born in a fishing village in Denmark. He was a homely boy—tall, thin, and sickly. He played by himself, for other children made fun of him. Sometimes his father, a shoemaker, read stories to him.

Hans's father died when the boy was only 11. Then Hans tried several kinds of work. He did not like any of them. But he did like singing and dancing for the other workers. He decided to be an actor. At 14 he went to the big city of Copenhagen and searched for work in the theaters.

For three years Hans had a hard time earning a living. He gave up the idea of being an actor and began to do some writing. At last the king of Denmark became interested in him. He furnished money for Hans to go to school. Later he gave him money for travel.

Hans wrote poems, plays, and stories of his travels. While waiting for one of his books to be published, he wrote four fairy tales. Children liked them so much that he kept on writing fairy tales. These stories made him famous. He became popular, too. The "ugly duckling" now had princes and famous writers and artists as friends.

STATE INSTITUTE OF EDUCAT
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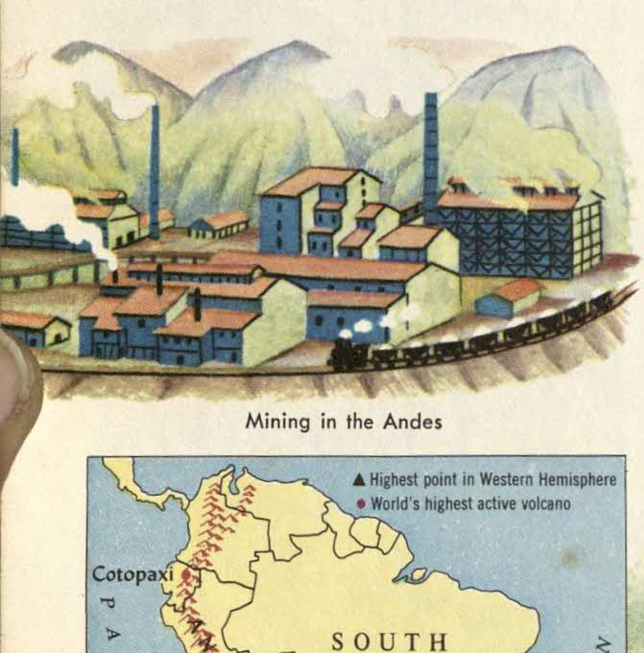
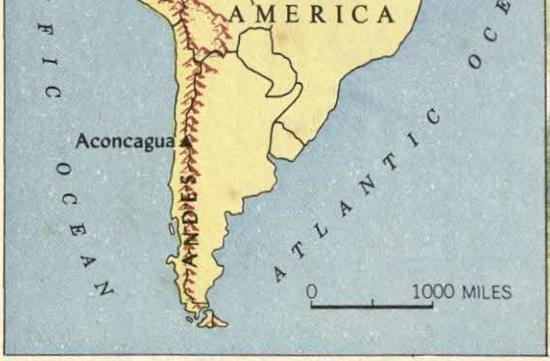
Christ of the Andes

ANDES The Andes Mountains are the "backbone" of South America. They run close to the west coast for more than 4,500 miles—the whole length of the continent. In places they are only a hundred miles wide. In other places they measure more than 400 miles across.



Mining in the Andes



These mountains are very high—much higher than the Alps or the Rockies. Aconcagua (ak un KAH gwa), near the border between Argentina and Chile, is not only the highest peak of the Andes but also the highest in the Americas. It rises 22,835 feet above sea level.

Here and there in the Andes there are active volcanoes. Cotopaxi, in Ecuador, is the highest active volcano in the world. It measures nearly 19,500 feet.

The Andes almost shut off the west coast of South America from the rest of the continent. There are passes through them, but for long stretches the lowest passes are more than two miles high. Travel across the Andes is far from easy. Even now there are few roads and railroads. Of course, airplanes can fly over mountains. The Andes, therefore, are much less of a barrier than they used to be.

These mountains are rich in minerals. There are stores of copper, tin, iron, and nitrates. Gold, silver, platinum, and even emeralds are found, too.

The Andes are about 65,000,000 years old. Some scientists think that they are still being pushed up. They are in one of the world's great earthquake belts, and earthquakes and mountain building often go together. (See MOUNTAINS; VOLCANO.)

Llamas, Beasts of Burden in the Andes.

ANDORRA High in the mountains between France and Spain is a picturesque little country called Andorra. It is so small that it would barely hold Philadelphia.

Andorra can trace its history back over a thousand years. It has been a separate country since the days of Charlemagne.

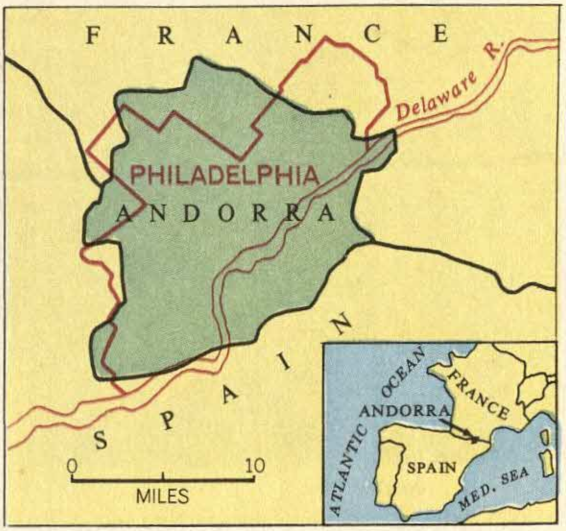
In all of Andorra there are only about 13,000 people. Most of them earn a living by raising sheep and cattle or by taking care of summer tourists. In the whole country there are only six villages. One of them, Andorra la Vella, is the capital. It is the smallest capital in the world.

ANESTHETICS One day in 1846 an experiment was being tried at a hospital in Boston. William T. Morton had given ether to a patient about to undergo an operation. Ether is an anesthetic. "Anesthetic" means "without feeling." No one was sure how the ether would work. It worked well; the patient felt no pain. This operation was a milestone in the long history of surgery.

For nearly 50 years people had known that they could breathe certain gases that would take away feeling. One or two minor operations had been performed after the patient had been given ether. Laughing gas (nitrous oxide), another anesthetic, had been used a few times to take away the pain of having a tooth pulled. But the use of anesthetics in surgery really began with the operation in Boston.

Today doctors use many different anesthetics. Ether and laughing gas are called general anesthetics. They make the patient unconscious. There are several newer general anesthetics. Some of these are put directly into the blood instead of being breathed in.

Some anesthetics deaden the pain in just one part of a person's body. These are local anesthetics. They do not make a person unconscious. One of the very common uses of local anesthetics is in dentistry. For certain operations cold has proved to be a good local anesthetic.



Anesthetics take away much of a patient's fear of an operation. They also make operations much safer, for a doctor can work better if the patient is not twisting in pain. Anesthetics have been called America's greatest gift to the world. (See COLD; HOSPITALS; MEDICINE.)

ANGKOR In 1861 a French scientist, Henri Mouhot, was hunting for rare plants in the jungles of what is now Cambodia. Deep in the jungle he came upon some ruins so marvelous that he could hardly believe he was seeing them. The ruins proved to be all that was left of Angkor, once one of the world's great cities.

Angkor was the capital of the kingdom of the Khmers (K'MERZ). This ancient kingdom in southeastern Asia was founded more than 1,500 years ago by people who had come from India by boat and settled there. They grew rich and soon were building cities. Around their capital city they built a high wall with a deep moat on the outside. Their walls and big buildings were made of great blocks of red sandstone.

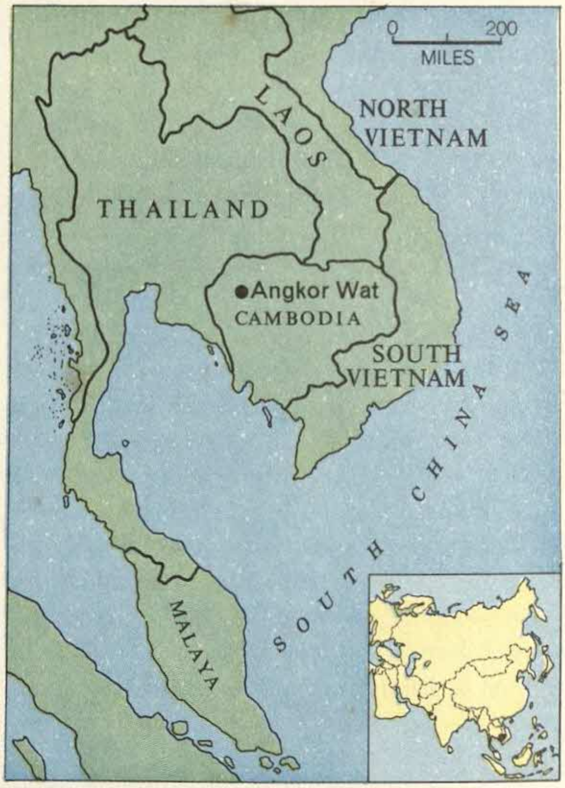
For several hundred years the Khmers were very powerful. But their glory came to an end. Enemies conquered them and drove them from Angkor. The conquerors destroyed some of the buildings and left the rest for the jungle to swallow up.

Angkor Wat

Ruins of Angkor in Cambodian Jungle

Now the ruins have been uncovered, and they are worth making a long journey to see. One of the great sights is the temple called Angkor Wat. It covers almost a square mile. A paved avenue leads to it. Some of its towers soar more than a hundred feet into the air. Carvings on the walls of the temple tell something of the life of the Khmers. They tell of battles and elephant hunts and great celebrations of that long-vanished people.

This huge temple was finished at the time that some of the great cathedrals in Europe were being built. It was not as well built as the cathedrals of Europe. The Khmers knew how to make beautiful buildings, but they did not know how to make firm foundations. Now all of Angkor Wat is empty except for a few monks who live in the ruins. Monkeys climb over the walls, and orchids grow in the cracks. Everywhere there is an air of gloom and mystery.



ANGLO-SAXONS About 1,500 years ago three Germanic tribes crossed over from Europe to what is now England. These tribes were the Jutes, the Angles, and the Saxons. The Britons had asked for help in driving out some enemy tribes that were pushing down from the north. The men of the Germanic tribes drove back the tribes from the north. But they also drove out most of the Britons and set up small kingdoms of their own. Three or four hundred years later these small kingdoms were joined into one. The people came to be known as Anglo-Saxons.

We call the language of the Anglo-Saxons either Anglo-Saxon or Old English. Many of the words in our language came from Old English words. But most of them have changed greatly on their way to us. Reading a book written in Old English is like reading a book in a foreign language.

The most famous Anglo-Saxon king was Alfred the Great. The last was Harold II.

In 1066 William the Conqueror crossed over from Normandy and defeated Harold in the famous Battle of Hastings. Then the Normans treated the Anglo-Saxons as harshly as the Angles and Saxons and Jutes had treated the Britons six centuries before. (See ALFRED THE GREAT.)

Anglo-Saxon Warriors

ANIMAL ASTRONAUTS Before any men became space explorers, animals of several kinds made trips into space. Laika, the little dog pictured above, was the very first animal astronaut. In 1959 Laika went aloft in the Russian satellite Sputnik II. For a week she traveled around and around the earth. Unfortunately, there was at that time no way of bringing a satellite back to earth safely. Since then many animal astronauts have returned from journeys in space none the worse for their trips.

Among the well-known animal astronauts are the chimpanzees Ham and Enos, the dogs Belka and Strelka, the monkeys Able and Baker, and the little black mice Moe, Sally, and Amy. The dogs went aloft in a Russian satellite, the chimpanzees, monkeys, and mice in American satellites.

Chimpanzees have been especially helpful. They are intelligent and can be taught to carry out certain tasks while out in space. Chimpanzee astronauts are sometimes called chimponauts.

Many animal astronauts help without ever really traveling out into space. They are used in experiments in space laboratories. A laboratory may have dozens of chimps to help in solving problems of space travel. Among the newer recruits for space travel experiments are tiny Nevada desert mice. These little mice eat nothing but seeds. They do not even have to have water to drink. Some of the satellites now being sent up carry so many kinds of small animals that they are regular Noah's arks.

Laika

Ham

ANIMAL BABIES Many baby animals —bears and elephants and turtles and thousands of others—look much like their parents. But many do not. A baby butterfly looks more like a worm than like a grown-up butterfly. Baby frogs look very much like fish. Oysters when first hatched do not have shells. Ants, bees, and jellyfish are other animals that change greatly in looks as they grow up.

Some baby animals weigh millions of times as much as other baby animals. The biggest baby of all is a baby blue whale. It weighs more than a grown-up elephant.

A horse usually has only one colt at a time. A cow usually has only one calf. One baby at a time is the general rule with elephants, giraffes, sea lions, sheep, and others besides. Bears often have twins.

Dogs, cats, pigs, rabbits, ostriches, robins, opossums, turtles, and many other animals have several babies—in some cases more than a dozen—at a time. And some animals have babies by the hundreds or even thousands. A cod may lay a million eggs. Not all the eggs are likely to hatch, but usually thousands of them do. Only a few, however, live to grow up. Tiny cod are

good food for bigger fish. Frogs, toads, and butterflies are among the other animals that have a great number of babies at once.

Some baby animals are well cared for by their parents. Some are not taken care of at all. A baby robin would not live long if its parents did not protect it and bring food to it. A baby turtle, on the other hand, can take care of itself as soon as it comes out of the egg.

Mother koalas carry their babies about just as human mothers do. So do mother monkeys, kangaroos, manatees, and sloths. As you see, a mother opossum has a way of giving all her babies a ride.

Some animal babies grow up fast. A hamster is naked and helpless when it is first born. But baby hamsters grow so fast that a hamster can have babies of its own when it is only two months old. An elephant, however, stays a baby for two or three years.

Young animals often have special names. Baby butterflies and moths are called caterpillars. Baby toads and frogs are called tadpoles. The list below gives common names for some other baby animals.

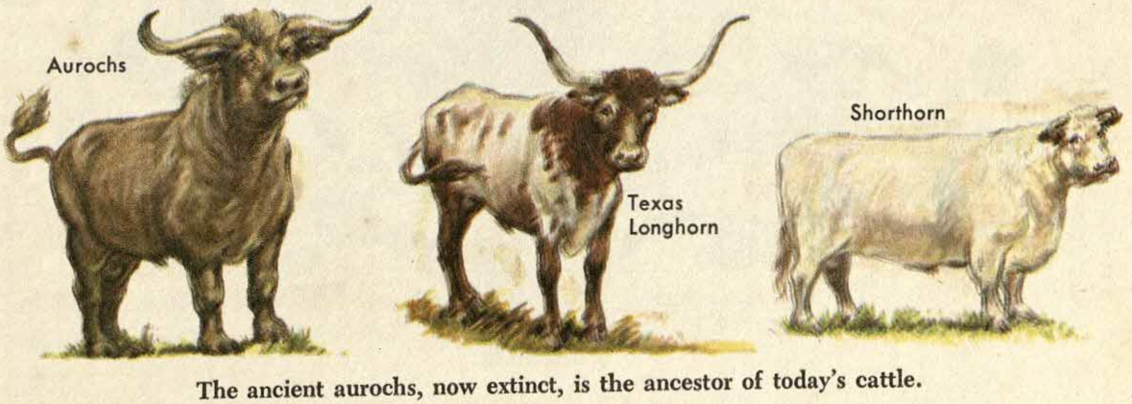
Ant Lion—doodlebug
Bear—cub
Cat—kitten
Deer—fawn
Dog—puppy
Duck—duckling
Elephant—calf
Fox—cub
Goat—kid
Goose—gosling
Kangaroo—joey
Lion—cub
Moose—calf
Seal—pup
Shark—puppy
Sheep—lamb
Swan—cygnet
Tiger—cub
Turkey—poult
Whale—calf

ANIMAL BREEDING Imagine what a caveman would think of a modern dog show! How hard it would be for him to understand that all the dozens of breeds of modern dogs have been developed from the dog that shared his fireside. He would probably not think of a Pekingese and a Great Dane as being close relatives at all. A caveman would be just as greatly surprised at our other domesticated animals. We have developed many different breeds to serve different purposes.

"Animal breeding" means developing new breeds of animals and improving those we have. It might be called "making animals to order." An animal breeder has a picture in his mind of the kind of animal he wants. Perhaps he wants a horse that will be able to run very fast, a cow that will produce very rich milk, a hog that can be fattened easily, or a sheep with especially long wool. He chooses and mates animals that he thinks may have offspring of the kind he has in mind.

Animal breeders have found out that it is very important to know about the ancestors of the animals they are mating. When a person buys a purebred animal today, he is given a record of the animal's ancestors. It is called a pedigree.

Often animal breeders cross two different breeds, sometimes even two different kinds of animals. Animals produced in this way are called hybrids. The mule is a hybrid between the horse and the donkey. Many herds of cattle are made up of hybrids between the zebu and other cattle breeds. (See HEREDITY; HYBRIDS.)



The ancient aurochs, now extinct, is the ancestor of today's cattle.

ANIMAL KINGDOM In the whole world there are known to be about a million different kinds of animals. Probably there are thousands and thousands more still to be discovered. All the many kinds of animals make up the animal kingdom.

When some people think of animals they think only of those such as dogs and cats and horses and bears. These animals all have hair, or fur. But animals without hair far outnumber those that have it. Ants and spiders and butterflies are animals. So are starfish and turtles and jellyfish. So are robins and corals and toads, earthworms and lobsters and snails.

An animal may weigh many tons. The bigger whales do. But some animals are too small to be seen without a microscope.

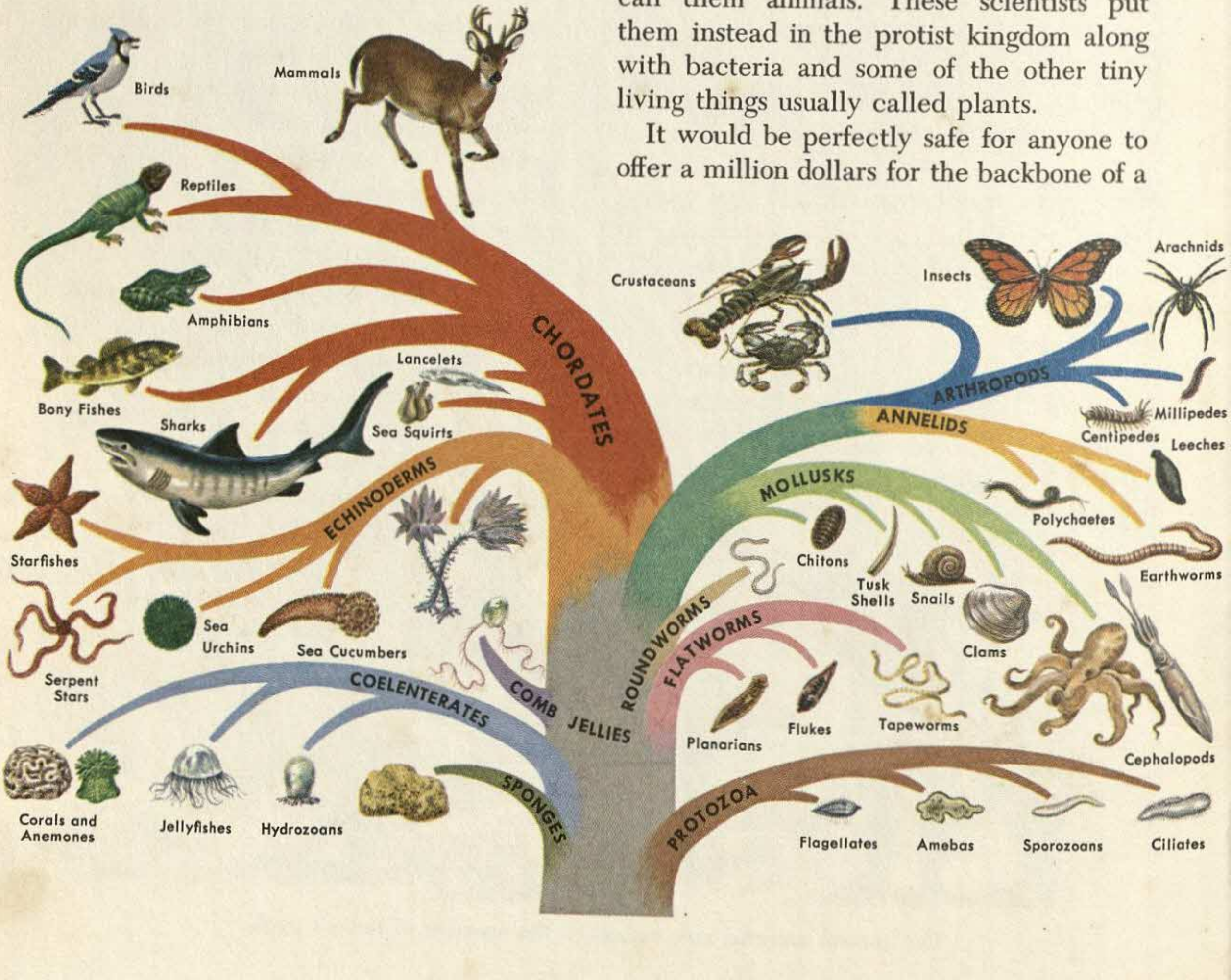
A robin and an ostrich are easy to tell apart. They are different in many ways. But a robin is much more like an ostrich than it is like a bear. In the same way, a bear is much more like a mouse than it is like a goldfish.

Scientists have studied ways in which animals are alike and ways in which they are different. They use the ways in which animals are alike and different to divide them into about 25 big groups. These big groups are called phyla (FY la).

The tree diagram below gives an overview of the animal kingdom. The eleven branches on which there are names stand for the most important phyla. The phyla not shown are made up mostly of little-known animals.

The simplest animals are at the bottom of the tree, the most advanced at the top. Notice that the lowest branch is marked PROTOZOA. Protozoa are one-celled organisms. They are so much simpler than most animals that many scientists do not call them animals. These scientists put them instead in the protist kingdom along with bacteria and some of the other tiny living things usually called plants.

It would be perfectly safe for anyone to offer a million dollars for the backbone of a



Two Members of the Cat Family

mosquito. He would never have to pay the million dollars. A mosquito does not have a backbone. The animals in only one phylum have backbones, and not quite all of them do. This phylum is the chordates.

The chordates, as you see, stand at the top of the animal kingdom. They include the fishes, amphibians, reptiles, birds, and mammals. Of the animals shown in the phylum, only the sea squirts and the lancelets have no backbones.

In this big phylum are the only warm-blooded animals—the birds and the mammals. The other chordates are like the animals of all the other phyla in being cold-blooded. Being cold-blooded does not mean always being cold. It means instead having to get the warmth needed from the surroundings. A cold-blooded animal may be very warm indeed if it is in the hot sunshine. But in freezing temperatures the animal is sure to be cold and inactive.

Scientists have a long name for animals that have backbones. They call them vertebrates. The name comes from the small bones, or vertebrae, that make up backbones. Scientists have a long name, too, for the animals that do not have backbones. They call them invertebrates. For millions and millions of years all the animals on the earth were invertebrates. Even now there are over 20 times as many kinds of animals without backbones as with backbones. The vertebrates, however, are far more conspicuous because of their size.

The big groups, or phyla, of animals are divided into smaller groups called classes. Classes are divided into still smaller groups called orders. These are divided into still smaller groups called families. Families are divided into genera (JEN er a), and genera are divided into species (SPEE sheez). When a scientist talks about kinds of animals he means species of animals.

Every animal has a scientific name. It is a Latin name which tells the animal's genus (singular of "genera") and species. The tiger and the common cat are in the same genus. The scientific name of the cat is *Felis catus*. The first part of the name tells its genus, the second its species. The name of the tiger is *Felis tigris*.

Our scientific name is *Homo sapiens*. We belong to the family Hominidae (ho MIN i dee). This family is in the order of primates. The primates belong to the class of mammals. The mammals, as you know, belong to the phylum of chordates, the group which includes all the vertebrates. (See INVERTEBRATES; VERTEBRATES.)

ANIMALS, FABULOUS The creature in the upper left-hand corner of the picture does not really need a name. Pictures of dragons are so common that almost everyone has seen them. There are many pictures of dragons in Chinese art, and in Chinese parades there are often big paper dragons.

There are stories of dragons from many parts of the world. The story of St. George and the dragon is one of them. Draco, the Dragon, is a constellation. An old Greek myth tells how it came to be in the sky.

Dragons are only storybook animals. There were never any real ones. No real animals breathe out fire, as the dragons of stories do.

There are many other such storybook animals. Since they are only in stories or fables, they are called fabulous animals. But people once really believed in them.

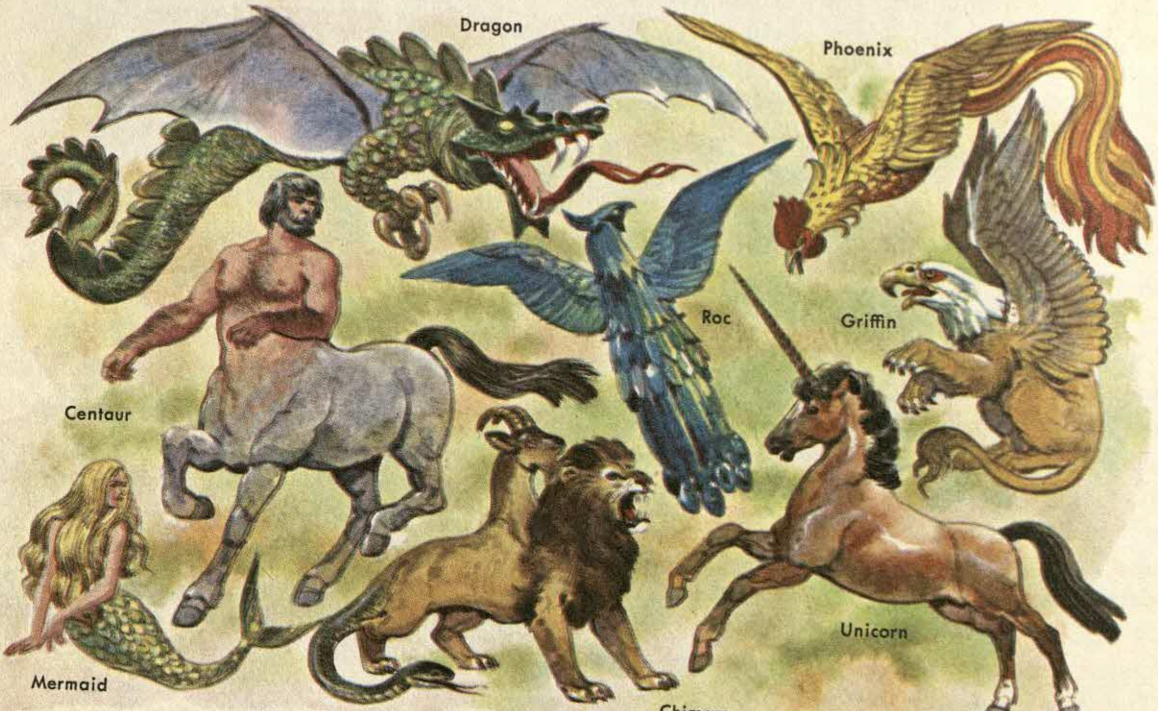
On the coat of arms of England there are two animals—a lion and a unicorn. The lion is a very real animal, but the unicorn is fabulous. There never were any unicorns. These animals were believed to be much like horses except that a unicorn had a long, twisted horn sticking out from its forehead. "Unicorn" means "one horn."

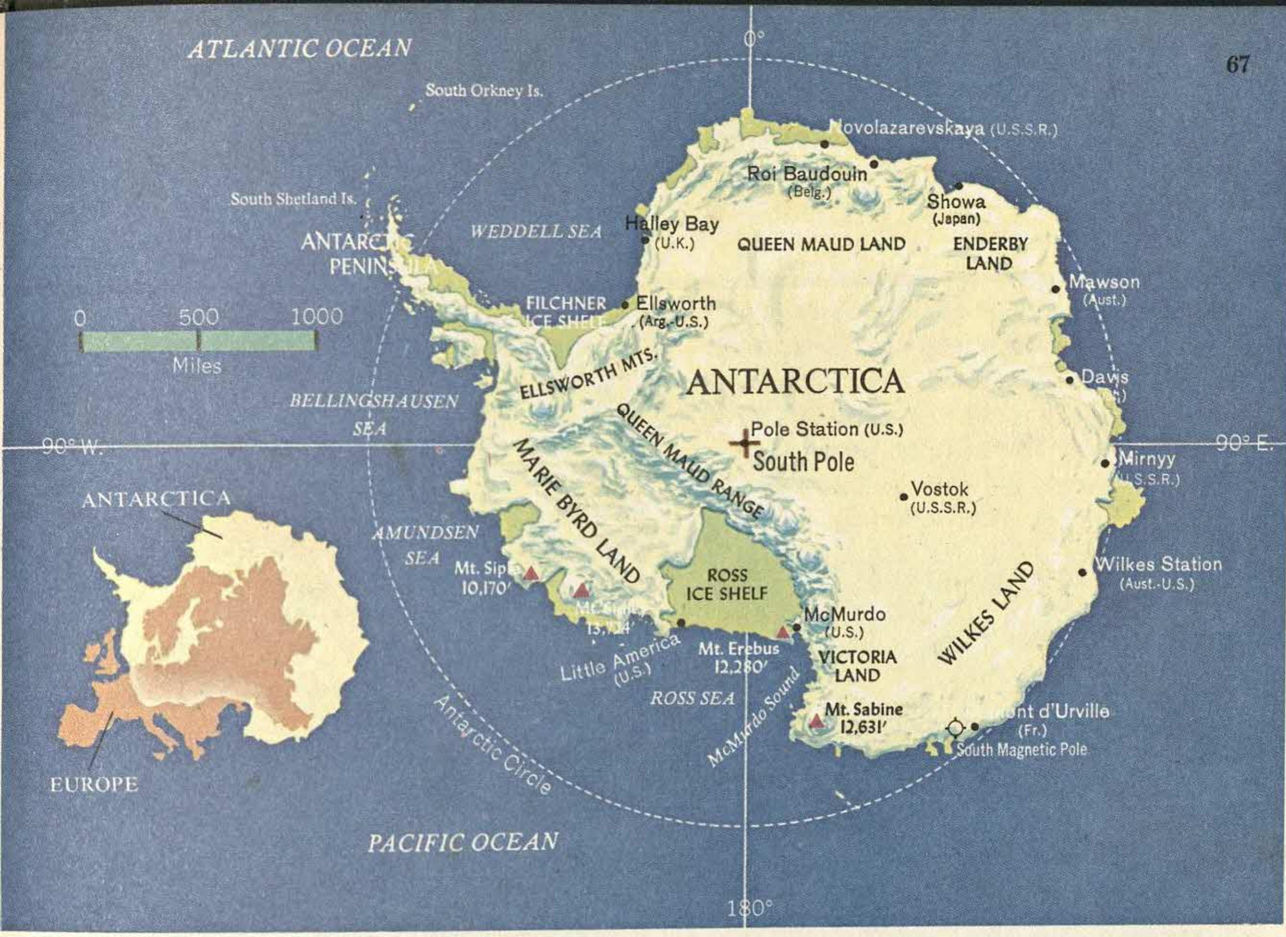
The roc and the phoenix are fabulous birds. A roc was supposed to be so big that it could pick up an elephant. A phoenix was supposed to live for 500 years. Then it built a great nest of sticks, set it on fire, and died in the flames. From the ashes a young phoenix rose.

Some fabulous animals were supposed to be part human. Centaurs had the bodies of horses and the heads and shoulders of men. Mermaids were sea creatures part woman and part fish.

Other fabulous animals were part lion, the animal which people think of as the king of beasts. The griffin had the body of a lion and the head and wings of an eagle. The chimera (ky MEER a) was part lion, part goat, and part serpent.

No one is sure where the ideas of most fabulous animals came from. Stories of them go far back into the past. Some of these stories were probably made up. Some must have come from things people really thought they saw. (See MERMAID.)





ANTARCTICA The highest, coldest, windiest, loneliest continent in all the world is Antarctica. It is bigger than Australia, but no one lives there. Much of it has not yet been explored.

The South Pole is in the middle of Antarctica. All the region around the Pole has a long, long winter, when for days, weeks, or even months the sun does not come up at all. At the Pole itself the long night lasts for six months. The region has a long, long "summer," too, when for days, weeks, or even months the sun never sets. Only parts of the fringe of Antarctica have sunrise and sunset every day of the year.

The winters in Antarctica are the coldest on earth. In 1960 a low of 126.9 degrees below zero set a record. Even in midsummer the temperature seldom goes above freezing. All but a small part of the continent is covered with a thick layer of snow and ice the year round. Enough water is frozen in Antarctica's ice cap to feed a river as big as the Mississippi for 50,000 years. Aprons of ice spread out into the ocean. The largest is the Ross Ice Shelf.

For great stretches Antarctica's ice is more than a mile thick. Not long ago at the edge of the cap a seal was found that had been frozen in the ice 2,000 years ago.

Through the ice cap tall mountains rise. One, Mount Erebus, is a live volcano. Plumes of steam drift from it.

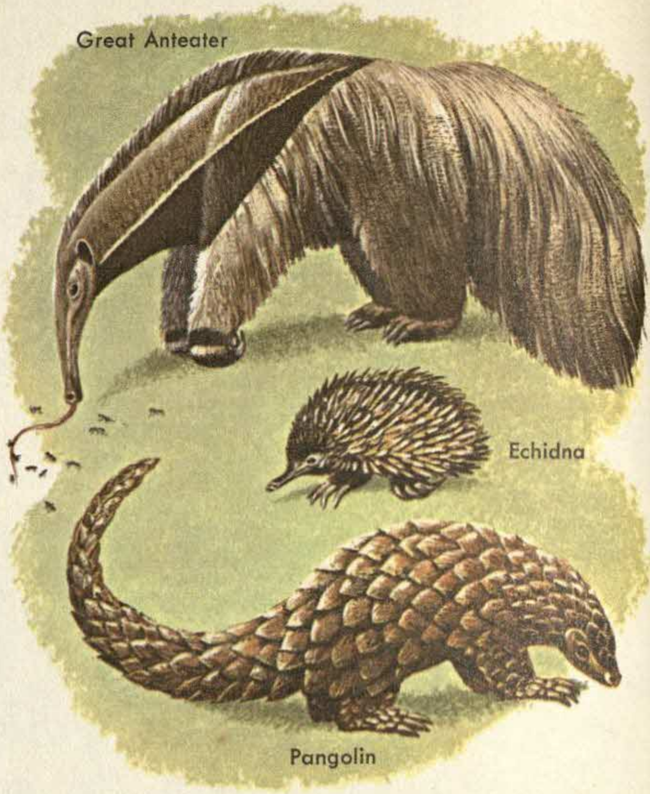
Except along its edges Antarctica is an absolute desert, empty of plants and animals. Near the shores, where temperatures go above freezing about 20 days a year, there are a few plants and insects. Sea birds nest there. Among them are comical-looking penguins. Whales, seals, and many kinds of fish live in the cold waters surrounding the continent.

Cold, mountains, and wind make Antarctica hard to explore. Many explorers have lost their lives in this desolate land. The first explorers in Antarctica were trying to reach the South Pole. The Pole, of course, has been reached. But explorers will keep on going to Antarctica. It holds the key to many of the earth's secrets.

During the past few years Antarctica has become a great science laboratory. A dozen or so countries now have bases there. One of the bases of the United States is right at the Pole. At the antarctic bases scientists study the weather, partly to help them understand the weather in the rest of the world. They study the stars and the auroras, the curtains of colored light that sometimes drape the sky. They find out more and more about earth history and about life in the cold sea today. At times they track satellites. At some bases atomic power plants have been set up to help the scientists with their work.

So far not many hundreds of people have spent a winter in Antarctica. But the vast space, large amounts of water to be had, and clean air may soon attract industry. Even now tours to Nature's biggest icebox have begun. (See AMUNDSEN, ROALD; BYRD, RICHARD EVELYN.)

ANTEATERS There are several kinds of anteaters. They are all rather strange animals. The picture shows three kinds. These three kinds do not look much alike and are not closely related, but they are all well fitted for catching ants and termites. They all have long, sticky tongues.



The great anteater, or ant bear, is the largest of the anteaters. It is found in South America. From its fur one can tell that it is a mammal.

The echidna, or spiny anteater, lives in Australia. It is a mammal, too, but it lays eggs. The mother usually lays two eggs at a time. She carries them in a fold of skin. The babies that hatch get milk from the mother, just as all mammal babies do.

The pangolin, or scaly anteater, is also a mammal, although it looks like a lizard. Its few hairs do not show. The pangolin lives in parts of both Africa and Asia.

ANTHROPOLOGY Where and when did the earliest men live? What were they like? How many races of men are there? How do these races differ from one another? Anthropology is the science that answers or tries to answer such questions as these. "Anthropology" comes from Greek words meaning "study of man."

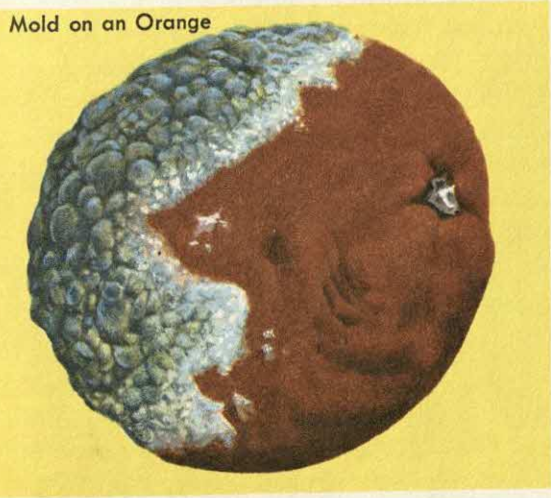
The study of man also includes a study of the cultures of the peoples of the past and the present. The culture of a people is their whole way of life: their houses, clothing, foods, tools, and cooking utensils; their music and dances; their language, folktales, and myths; their art and religion; their customs and laws.

Anthropology has many branches. Archeology, the study of the relics people of earlier times have left behind, is one of them. (See ARCHEOLOGY; ETIQUETTE; HOMES; MAN; RACES OF MANKIND.)

ANTIBIOTICS For centuries people thought of the little plants called molds as just a nuisance. Molds grow on bread, fruit, and other foods and spoil them for eating. They spoil the looks of cloth and leather, too. In time, however, people found that molds can be used to give special flavors to cheese. They came to realize that molds are also a help in making dead plants and animals decay. But not till the 20th century did molds become lifesavers by furnishing "miracle drugs" called antibiotics. Today there are dozens of antibiotics. They come not only from molds but also from bacteria and other small colorless organisms.

Penicillin, discovered in 1928, was the first of the antibiotics. One of the best known of the later ones is streptomycin.

The word "antibiotic" means "against life." Antibiotics certainly fight against the living germs that cause many diseases. Because we have antibiotics, some diseases that used to kill thousands of people every year are no longer so dangerous. Pneumonia and scarlet fever are two of them.


Mold on an Orange

Antibiotics do more than help fight disease. When tiny amounts of some of them are added to the feed of animals we raise for meat, these animals grow much faster.

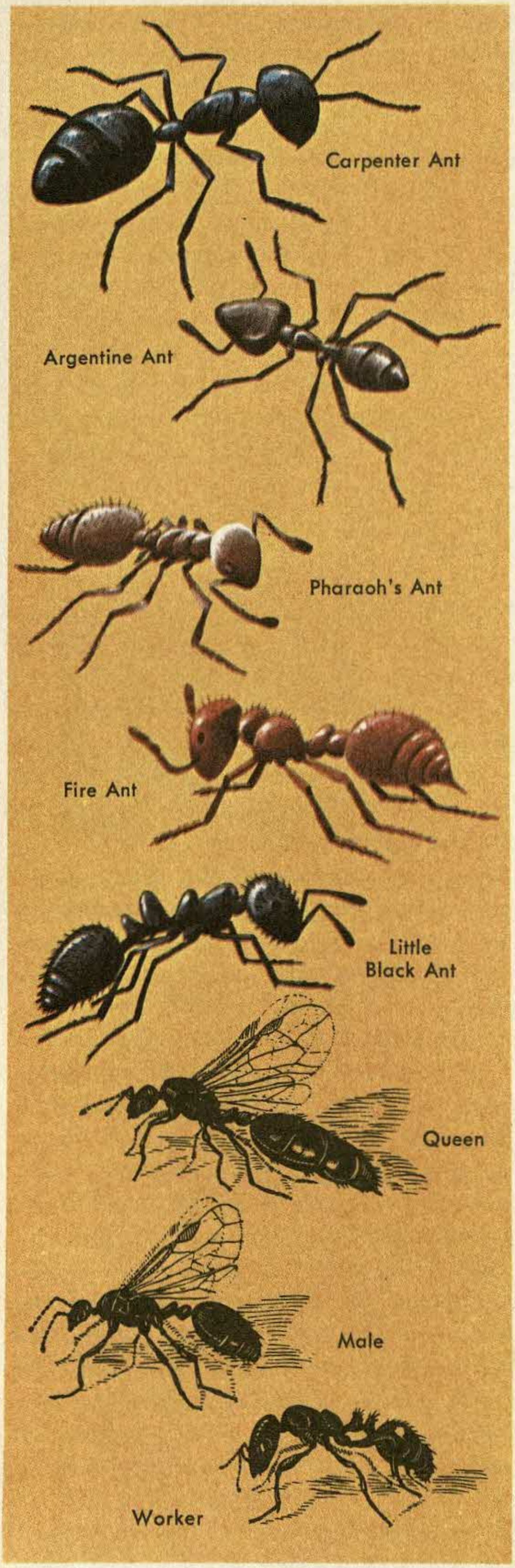
Antibiotics are wonderful medicines, but everyone should be careful about using them. More than the right dose may be harmful. Some people, moreover, are allergic to one or more of them. And, if antibiotics are used too often for little illnesses, they may fail to help when they are needed most. (See PENICILLIN.)

ANTISEPTICS Almost every medicine cabinet or first-aid kit has some kind of antiseptic in it. An antiseptic is a chemical used to either kill germs or keep them from growing. Antiseptics are used especially to keep wounds from getting infected from germs that get into them and to fight infections that have already begun.

Before the middle of the 19th century no one knew anything about either antiseptics or germs. Roughly half of all the people operated on died because their wounds became infected. In the 1860's the famous French scientist Louis Pasteur showed that when things spoil or decay it is because of organisms that have got into them. Joseph Lister, an English surgeon practicing in Glasgow, Scotland, heard of Pasteur's work. He wondered whether germs could be getting into wounds and infecting them.

He decided to try using something to keep germs from getting in. He used carbolic acid. The results showed clearly that the idea was a promising one. The time of safe, antiseptic surgery had begun.

Today carbolic acid is little used as an antiseptic. Many better antiseptics have been found. It is wise to ask a doctor's advice before buying one to have on hand. (See ANTIBIOTICS; PASTEUR, LOUIS.)



ANTS People live in groups and divide up the work to be done. In a village one man may be a doctor, another a farmer, another a policeman, and so on. Many animals live in groups. There are herds of deer, schools of fish, and colonies of birds. But only a few kinds of animals divide up their work. Among them are the ants.

There are thousands of kinds of ants. They are scattered far and wide over the world. The pictures show a few of the many kinds common in the United States.

Ants are insects. Because of the way they live they are called social insects. They all live in groups, or colonies. The different kinds of individuals that make up a colony are called castes. There are always at least three castes in an ant colony —workers, queens, and males.

Some ant colonies are much larger than others. An ant colony is made up mostly of worker ants. There may be several castes of workers. The workers are female ants, but they do not lay eggs. Only queen ants lay eggs. As a rule, young queens and male ants have wings. After mating, the queens tear off their wings. The males die.

Some of the worker ants of a colony gather food. Some do the housekeeping and take care of the queen and the baby ants. Some guard the nest. The workers that guard the nest may be bigger and have stronger jaws than the other workers. If so, they are called soldiers.

An ant colony is often marked by an anthill. To make rooms underground to live in, the workers carry sand up to the surface and dump it. But not all ants live underground. Carpenter ants live in dead wood. Some ants live inside people's houses.

All ants have four stages in their life histories. They are first eggs, then tiny, wormlike larvas, next pupas, and finally full-grown ants.

Many ants have "cows." The cornfield ant is one of them. Its "cows" are plant lice. Plant lice give off tiny drops of sweet honeydew when stroked. The ants eat the honeydew. Some ants have treehopper, scale insect, or beetle "cows."

No ants have more curious habits than the parasol ants and army ants. These ants live only in very warm regions.

Parasol ants raise underground gardens of fungus plants much like tiny mushrooms. Worker ants bring in bits of leaf for the fungus plants to grow on. The bits of leaf look like tiny parasols as the ants carry them along.

Army ants travel about in large armies. They build bridges and nests out of their own bodies. These ants are fierce. Even an elephant tries to get out of the way of an ant army. (See PLANT LICE.)

APES Of all our animal relatives, the apes are most like us. They belong to the same group of mammals we belong to. This group is called the primates.

Apes do not have tails. In this way they are different from the monkeys, which are primates, too.

In the Americas and Europe apes are seen mostly in zoos. Their real homes are in Old World lands near the equator.

In their native homes all the apes except gorillas spend most of their time in trees. With their strong arms they can easily swing from limb to limb.

The gorillas are the largest and most powerful apes. A big gorilla may weigh 400 pounds. Gorillas walk on all fours. They have ears much like ours.

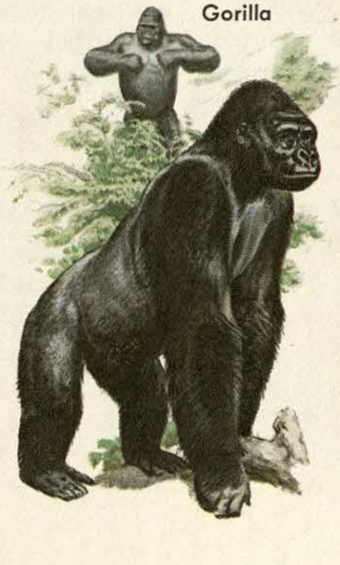
All the apes are intelligent, but the chimpanzees are the most easily taught. Some chimps have learned to skate, ride bicyles, and paint pictures. At least one learned to say "Mamma" and "Papa." A number of "chimponauts" have made flights into space.

An orangutan looks like an old man. Many orangutans live by themselves.

Gibbons walk erect much as we do. They have very long arms. A gibbon's hands often touch the ground when it is walking. Imagine shaking hands with such a long-armed fellow! (See ANIMAL ASTRONAUTS; MAMMALS.)

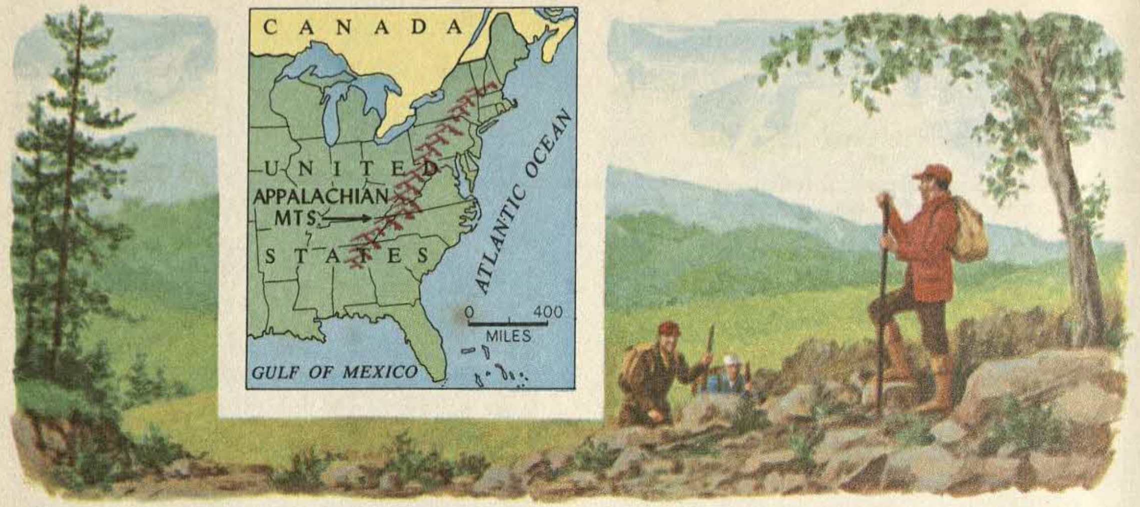
Orangutan

Gibbon



Gorilla

Chimpanzee



APPALACHIANS The Appalachians are mountains in the eastern part of North America. They are made up of many different ranges. The Blue Ridge Mountains, the White Mountains, the Green Mountains, and the Black Mountains are all part of the Appalachians. So are the Alleghenies, the Adirondacks, and the Great Smokies.

The explorer De Soto and the Spaniards under him named the Appalachians. They named them for the Apalachee Indians.

The Appalachians are old even for mountains. They are far older than the Rockies or the Himalayas (hi MA la yaz) or the Alps. The Appalachian story begins about 230,000,000 years ago.

Before that time there was a great trough where the Appalachians are now. The floor of the trough was covered by an arm of the sea. But then the floor began to be pushed up in big folds. All the region became dry land. The folding went on very slowly. Even if you had lived for years at the top of one of the folds you would not have noticed any change.

As soon as the folds were pushed up out of the water, wind and running water began wearing them down. But the folding went on faster than the wearing away. At last there were mountains where the trough had been.

The upward push finally stopped, but the wearing away went on. The folds were broken up into mountain peaks by wind and water. Then little by little even these peaks were worn down. After many millions of years the whole region was worn down to an almost flat plain.

But again a pushing up began. More mountains were formed. After millions of years they, too, were worn down to a plain. Ever since then there have been times when the land was pushed up faster than it was worn down, and times simply of wearing down. Now the Appalachians are in a wearing-down period.

These mountains had a great deal to do with the early story of our country. For a hundred years or so they kept the early settlers from moving to the West.

APPENDIX Some parts of our bodies do not seem to be of any use. One of these is the muscle back of each ear. Another is the appendix.

The appendix is shaped much like a worm. It is a dead-end section of the long food tube. It stands out from the large intestine near where the large and small intestines join. As a rule the contents of the food tube pass by the opening into the appendix. But occasionally some may enter, be trapped there, and cause the disease called appendicitis. Operating to remove the appendix is the common way of treating this disease. (See BODY, HUMAN.)

APPLES "A is for apple." Many ABC books begin this way. Apples are so common that even very young children know them. They can be bought in fruit stores the year round.

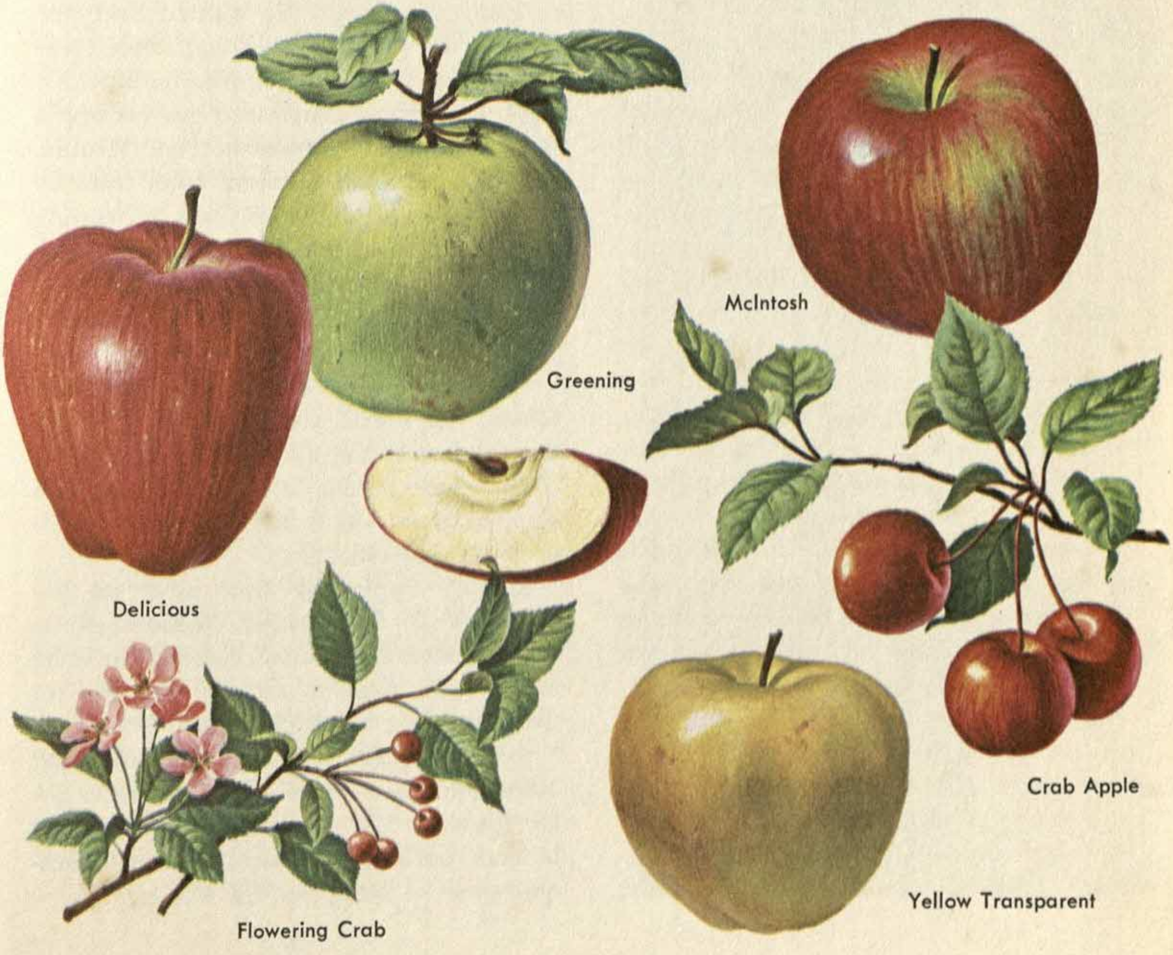
In American woods there are many wild crab apple trees. The earliest apple trees probably bore apples very much like the little crab apples on these trees. But the apple trees in American orchards did not come from the wild crab apple of America. Instead, they came from apple trees brought to America from Europe.

The apple reached America soon after the "Mayflower." An early governor of Massachusetts Bay Colony planted some apple trees in 1629. But apples had been raised in other lands centuries before that.

The first people who raised apple trees probably did not dream that apples would ever be as big and beautiful as they are now. They probably did not dream either that there would be so many kinds. In the orchards of the world there are thousands of varieties.

Many apples have interesting stories. The Golden Delicious is one. In 1912 a farmer in West Virginia had a big surprise. A young apple tree on his land began to bear big yellow apples of a new kind—the very first Golden Delicious apples. The farmer sent some apples from the tree to a nursery where apple trees are raised. One morning a man from the nursery came to buy the tree. He paid $5,000 for it. He couldn't take the tree home with him. Instead, he had a high fence built around it. The tree had to be protected. If it died, there might never be another tree like it anywhere in the world.

Five thousand dollars is a big price for one apple tree. But the nursery man knew



that he could raise many other Golden Delicious trees from it. He could cut off branches and graft them to the roots of hardy young trees.

Most of the apple trees of today's orchards are grafted. Apple trees can be raised from seeds. But orchard owners cannot risk raising their trees from seeds. They cannot be sure what kinds of apples they will get from trees raised in this way. In most cases an apple blossom will not produce an apple unless pollen from another apple tree is brought to it. In many cases the pollen must come from a different kind of apple tree. The baby apple tree in an apple seed may very well, then, have two parents. If its parents are not alike, the young tree may grow to be more like one of them or more like the other. It is almost sure not to be exactly like either.

Of course, if an orchard owner is trying to get a different kind of apple, he does raise apple trees from seeds. There is a chance that a young tree may be hardier than its parent or parents, produce better apples, or be better in some other way. The first Golden Delicious apple tree certainly grew from a seed.

The best apples for eating are not the best apples for cooking. The best apples for keeping are not the best tasting. The prettiest apples are not always the best tasting, either. But people do not agree about what kind tastes best. (See GRAFTING.)

APPLESEED, JOHNNY (1774–1845) More than a century ago a man named John Chapman was well known to the frontier settlers in Pennsylvania, Ohio, Indiana, and Illinois. But most of these pioneers did not know him as John Chapman. They called him Johnny Appleseed.

Barefoot, dressed in rags, and wearing an old saucepan for a hat, Johnny would appear at a lonely farmhouse carrying a bag of apple seeds. Sometimes he traded the seeds for food. But if the people were poor he gave them seeds. He wanted everyone to have the pleasure of seeing apple trees in bloom and of having apples to eat.

At first Johnny Appleseed got his apple seeds from cider presses in Pennsylvania. Later he collected his seeds from trees he had planted earlier. In his years of roaming through the countryside, he started many orchards. Some of our apple trees of today are descendants of trees Johnny Appleseed planted. All Rome Beauty trees are.

The lonely settlers were glad to have Johnny Appleseed come to visit. He told the children stories and carved whistles for them. After supper he would lie on the floor and read aloud from the Bible he always carried with him.

Johnny Appleseed was used to the hardships of the frontier. Sometimes he camped with the Indians. Several times he brought warnings to settlers that Indians were planning to attack them.

Johnny Appleseed loved the birds and other animals of the forest, and would not kill them even for food. A story is told that he once put out his campfire because mosquitoes were flying into the flames.

APRIL FOOLS' DAY The first day of April is called April Fools' Day. On that day people play jokes on other people. Tying a purse to a string and laying it on a sidewalk is one common prank. When someone tries to pick up the purse, the person who put it there jerks it away and shouts, "April fool!"

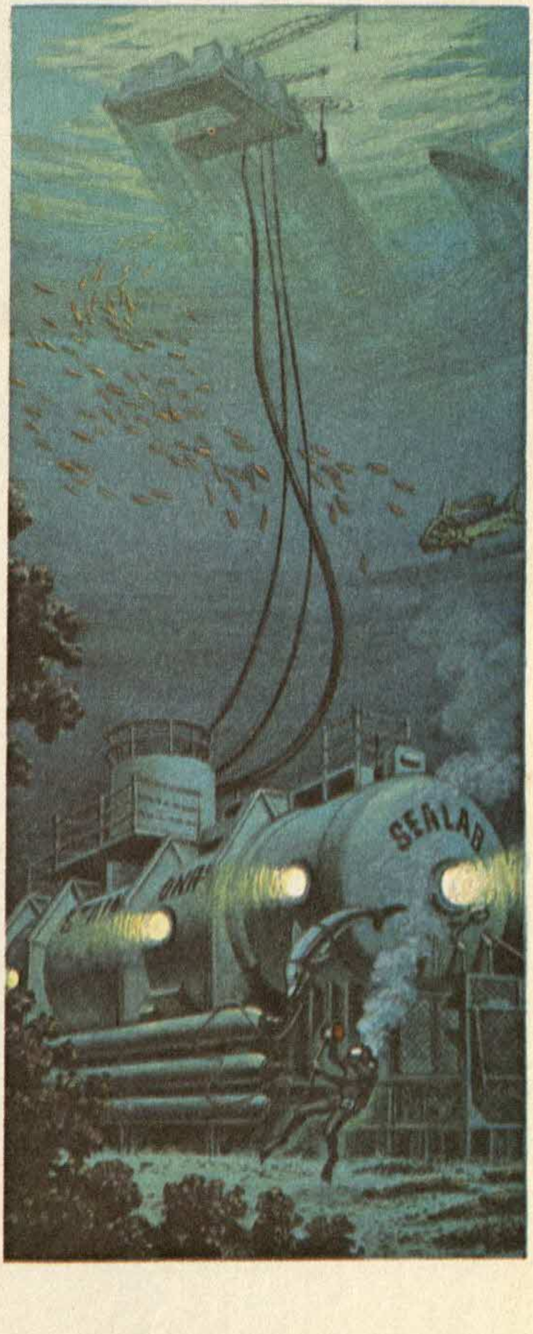
No one knows how the idea of April Fools' Day began. People have played pranks on that day for hundreds of years. As an April Fool's joke, a radio program broadcast in Switzerland on April 1, 1967, announced that spacemen from the United States had landed on the moon.

AQUANAUTS The explorers one hears most of today are the astronauts and the aquanauts. The astronauts explore outer space—the regions high above the earth's surface. The aquanauts study the depths of the sea—"inner space."

For many years divers have done some exploring of the ocean floor in diving suits of various kinds. In submarines and such devices as the bathysphere and the bathyscaphe explorers have gone deep into the sea. Many of the scientists who wanted to study the sea were not satisfied. They wanted to go down to the bottom of the sea, stay for days or even weeks at a time, and walk about on the ocean floor. To give them a chance to do so, undersea laboratories like the one shown in the picture have been set up in different places. The men who go exploring in this way are the aquanauts, or oceanauts.

Living under the sea is not easy. One big problem is pressure. On land at sea level the air pressure is about 15 pounds a square inch. Just 500 feet down in the sea the pressure is many times as great. In a sea-bottom house the "air" must be compressed enough to push out as hard as the water is pushing in. But aquanauts cannot safely breathe ordinary air so greatly compressed. They would get too much nitrogen. Therefore helium is substituted for most of the nitrogen. But helium has some strange effects. For one thing, it makes voices so high and squeaky that it is hard for aquanauts to talk with one another.

To walk about on the floor of the sea an aquanaut must have a special suit to protect him from the cold. He must carry a supply of oxygen with him. And he must look out for sharks. The aquanauts who lived in "Sealab II" near the coast of Cali-



fornia had Tuffy, a porpoise, to help them. Tuffy swam nearby and helped keep sharks away. He also guided aquanauts who lost their way back to their undersea home.

Coming up to the surface after being deep in the sea is a problem, too. To keep from getting the bends, a very painful disease, an aquanaut must spend hours in an air lock, where the pressure on his body is gradually lessened. In spite of the hardships, aquanauts will continue their work. The sea has vast treasures. And it holds almost as many mysteries as outer space. (See DEEP-SEA EXPLORING.)

AQUARIUM An aquarium is a man-made home for water plants and animals. Glass walls make it easy for people to study or just look at the living things inside. The pictures below offer some helps in setting up a small aquarium.

Plants in an aquarium make it look attractive. They also help to keep the water fit for animals to live in. Animals that live in water get oxygen from the water. They throw away carbon dioxide. During the daytime green plants use up carbon dioxide and throw away oxygen. The plants also use up some of the other animal wastes.

Tiny green plants called algae may grow in the water and on the walls of an aquarium. They may grow so fast that they hide the animals. Snails eat these tiny plants. They eat leftover fish food, too. An aquarium does not need cleaning so often if there are snails to do some of the work.

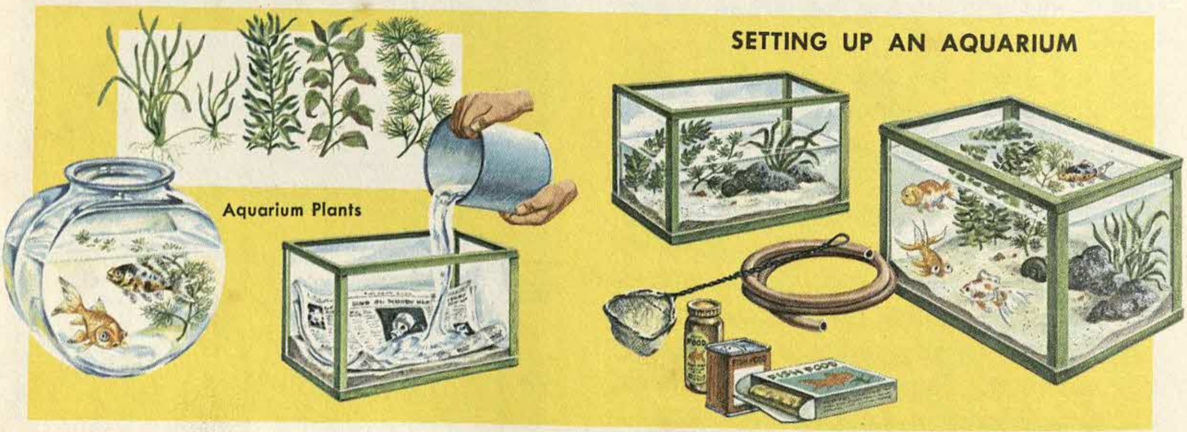
The aquariums in the picture are freshwater aquariums. Many kinds of plants and animals besides the ones shown can be raised in such aquariums. Tropical fishes, tadpoles, newts, freshwater clams, and duckweed are among them. It is possible to have a saltwater aquarium, too, with living things of the sea in it. But taking care of a saltwater aquarium is not easy.

In some cities there are big buildings that are also called aquariums. In them there are tanks showing many kinds of water plants and animals. Such aquariums may have animals as big as sea cows and porpoises. An outdoor marine aquarium, or oceanarium, may even have a whale or two—but not a great blue whale.

AQUEDUCT A big city needs an enormous amount of water. Some cities are on large lakes or rivers. They find it easy to get enough. But some cities have to have water brought in aqueducts from many miles away. The word "aqueduct" comes from Latin words meaning "water" and "to lead."

An aqueduct may be a big ditch walled with stone, brick, or concrete. It may be a tunnel deep underground. It may be a great steel or concrete pipe on top of the ground.

The idea of aqueducts is not new. Many cities of ancient times got water through aqueducts. The aqueducts that brought


SETTING UP AN AQUARIUM

Roman Aqueduct

water to Rome, a city built on hills, are famous. In bringing water to the city, the aqueducts had to cross many valleys. They crossed on great stone arches.

Los Angeles, New York, and San Francisco are three of the big cities in the United States that get their water through aqueducts. Billions of gallons of water travel through these aqueducts every day.

An amazing aqueduct in Australia has to lift its water a quarter of a mile in its 350-mile course to a dry gold-mining region. The water is pumped higher step by step.

Some aqueducts carry water for irrigation. Others lead to hydroelectric plants. (See WATER SUPPLY.)

ARABIA A great peninsula measuring about a million square miles stretches southward from western Asia. It lies between the Red Sea and the Persian Gulf. The Indian Ocean borders it on the south. This peninsula, the largest in the world, is Arabia, the original home of the Arabs.

Three-fourths of Arabia is desert. In vast areas of it no crops can be raised. Rub' al Khali in the southern part of the peninsula is one of the most fearsome of the earth's hot, dry deserts. Its name means "empty quarter," and it is truly almost empty of life. In the whole Arabian Peninsula there is only one river—a short one near the coast—that flows the year round.

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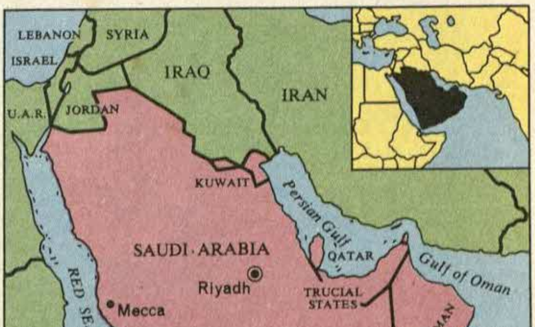
The country of Saudi Arabia takes up most of the peninsula. There are, however, a number of small countries, too.

When one thinks of Arabia, one is likely to think of Bedouins in long flowing robes riding Arabian horses. The Bedouins are nomadic desert tribes. Today they are greatly outnumbered by the townspeople.

Arabia's wealth is now mostly in its oil. From its wells many millions of tons of oil are pumped each year. In oases and regions with enough rain dates and wheat are important crops. On grazing lands camels, horses, donkeys, and sheep are raised.

Arabia is only a part of the "Arab world." In the seventh century the Arabs



began the building of a great empire. At its height it reached westward across the northern coast of Africa and into Europe. It also stretched eastward to India. The Arab empire broke apart, but Arabs remained in many of the lands that had made it up. Iraq, Syria, Jordan, Lebanon, Tunisia, Sudan, Algeria, Morocco, and Egypt (United Arab Republic) are included in the Arab world along with the countries of Arabia itself. Today the peoples of all these lands are tied together largely by their religion. They are Moslems; they follow the teachings of Mohammed. Mecca and Medina, sacred cities of the Moslems, are in Saudi Arabia.

The rest of the world owes much to the Arabs. From them came many ideas of art and science. The numerals we use, for instance, are called Hindu-Arabic numerals. The Arabs were pioneers in medicine and astronomy. They were also famous for their mosaics and their work with metals. (See HISTORY; MOHAMMED; MOORS; NEAR EAST; NOMADS.)

ARABIAN NIGHTS This is the name of a famous collection of stories. Another name for the collection is *A Thousand and One Nights*.

These stories were supposed to have been told to a sultan of the East by his beautiful wife Scheherazade (shu hay ra ZAH da). The sultan was a cruel man. For a time he married a new wife every day. And every day he cut off the head of the wife he had married the day before. When he married Scheherazade she had a plan for saving her life.

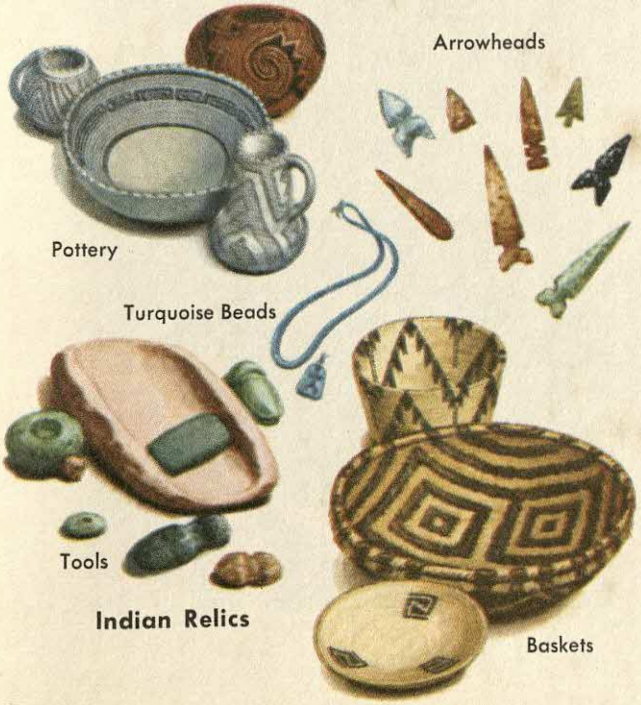
The first night she told the sultan part of an interesting story. She promised to tell him the rest the next night. He decided to let her live one more day. Night after night she finished one story and began another. And day after day the sultan put off killing her. For a thousand and one nights she followed the same plan. By that time the sultan was very much in love with her and wanted her to live.

Of course, the story of Scheherazade is not true. No one person made up all the stories in *Arabian Nights*. They came, in fact, from different parts of Asia. For hundreds of years they were merely told aloud by storytellers. But at last they were written down. They first reached Europe early in the 1700's.

One of the most famous stories in the collection is about Sinbad the Sailor and his voyages. Another is about Ali Baba and the Forty Thieves. Still another is about Aladdin and his wonderful Magic Lamp. No wonder stories as exciting as these have been told and read for centuries! (See HARUN AL-RASHID.)

ARBOR DAY Once a year a day in spring is set aside in each state for planting trees. This day is Arbor Day. It is not the same day every year, nor the same day in all the states. The first Arbor Day was celebrated in Nebraska in 1872. The other states soon followed Nebraska's lead. Arbor Day is also celebrated in parts of Canada.

ARCHEOLOGY People lived on the earth for thousands of years before anyone knew how to write. Even long after writing began in some places there were great groups in other parts of the world who could not write. None of these people could leave any written records of how they lived. All that we know about their lives has come from the study of such things as the pottery and jewelry they made, the weapons they used, and the bones of the animals they killed. Such things are often found in the ruins of their villages or in the graves where they were buried.

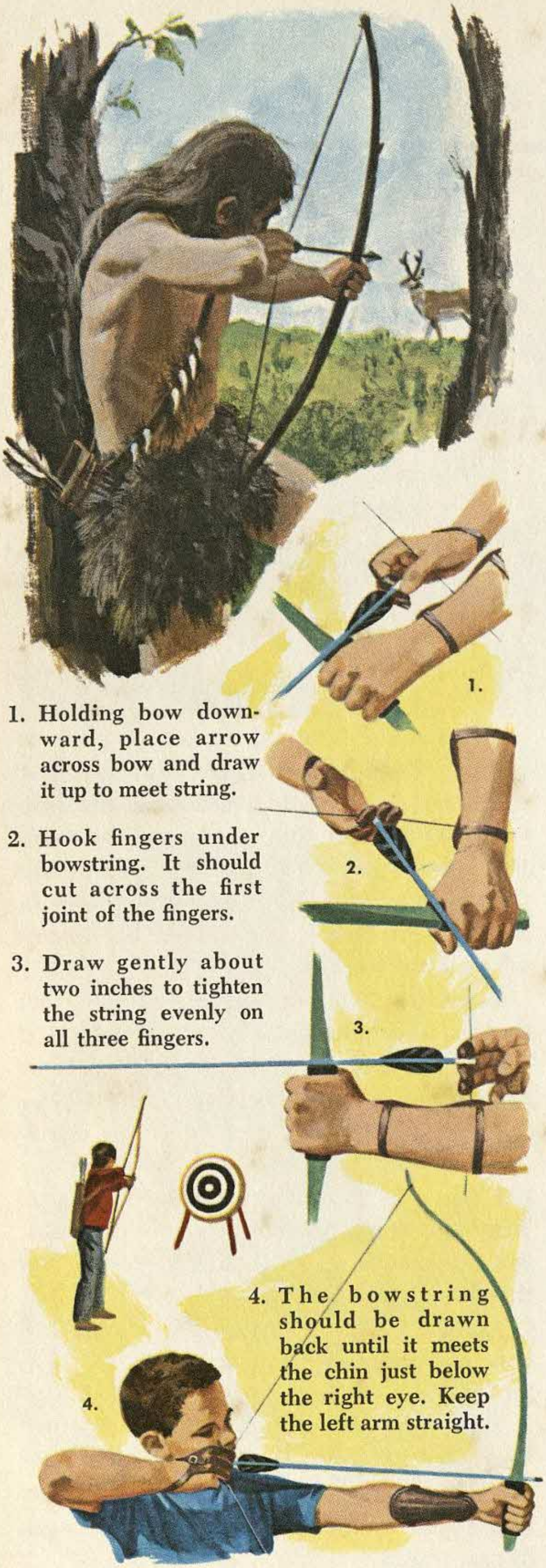


Indian Relics

Learning about the people of long ago through the belongings they left behind is called archeology. "Archeology" comes from two Greek words. One means "old," the other "study."

Archeologists do not study only the people of early times who could not write. They also study ancient people who could. But they learn about them chiefly through the things they made.

Archeologists make many surprising discoveries. Some archeologists once decided, for instance, to find out if there ever was a Troy—the city the story of the Trojan War was written about. They found the ruins of not just one city. Piled one on top of another the archeologists found the ruins of nine cities!



1. Holding bow downward, place arrow across bow and draw it up to meet string.

2. Hook fingers under bowstring. It should cut across the first joint of the fingers.

3. Draw gently about two inches to tighten the string evenly on all three fingers.

4. The bowstring should be drawn back until it meets the chin just below the right eye. Keep the left arm straight.

ARCHERY Stories of Robin Hood and his men tell of many archery contests. Centuries ago archery—shooting with a bow and arrow—was a popular sport. It still is.

Archery, however, did not begin as a sport. The bow and arrow was one of early man's best weapons. Thousands of years ago he used it in hunting and as a weapon of war. Inventing it was a great achievement. And to the end of the Middle Ages many hunters and soldiers used bows and arrows. The bow and arrow, moreover, was more deadly than many people would guess. An English longbow could drive an iron-tipped arrow right through an enemy. Even today explorers near the Amazon fear the arrows of Indians there. But, after gunpowder was invented, archery became chiefly a sport.

Three main kinds of archery contests are held now: target shooting, flight shooting, and field contests. In target shooting the archer aims at a bull's-eye on a target. Flight shooting is for distance only. Field contests are held for those interested in hunting with bow and arrow.

Yew, hickory, and Osage orange are good woods for bows. Birch and pine are good woods for arrows. All arrows have feathers to help them fly true. Newer materials for bows and arrows are aluminum and fiber glass. (See PATRIOTS; ROBIN HOOD.)

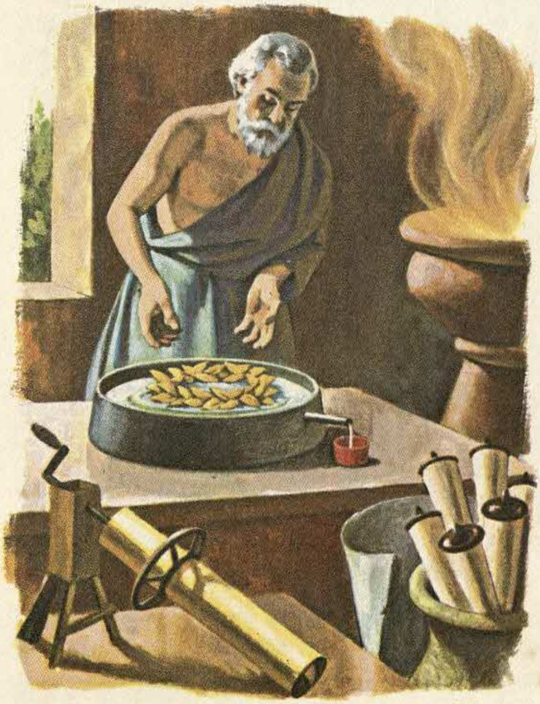
ARCHIMEDES (ar ki ME deez) (287?-212 B.C.) Some 2,200 years ago Hiero was the ruler of the Greek city of Syracuse. One day he called in a goldsmith, gave him a lump of gold, and told him to make a crown. The crown was soon finished. Then Hiero heard that the goldsmith had stolen part of the gold. The crown weighed exactly what the lump of gold had weighed. But the goldsmith might have replaced some of the gold with an equal weight of silver. Hiero asked the famous scientist Archimedes to find out.

At first Archimedes was puzzled. He knew that if silver had been used in place of some of the gold, the crown would not take up exactly the same amount of space as if it were pure gold. But how could he tell how much space the crown took up?

One day as Archimedes got into his bath, he noticed the water rise. He jumped from the bath shouting, "Eureka!" ("I have found it!") He had thought of a way to solve the problem. He would fill a vessel level full of water, then put the crown in it and measure the water that overflowed. He would do the same with a lump of gold of the same weight. If the crown was pure gold, the amounts of water that overflowed would be the same. They turned out not to be. The crown was not pure gold.

Archimedes made many discoveries. He found out how much an object is buoyed up in water. He experimented with mirrors, lenses, screws, and levers. "Give me a place to stand and a lever long enough, and I will move the earth," he once said.

Archimedes was killed when Syracuse was captured by the Romans. Legend says that he was so busy when a Roman soldier came that he did not even look up. He only said, "Don't disturb my circles."

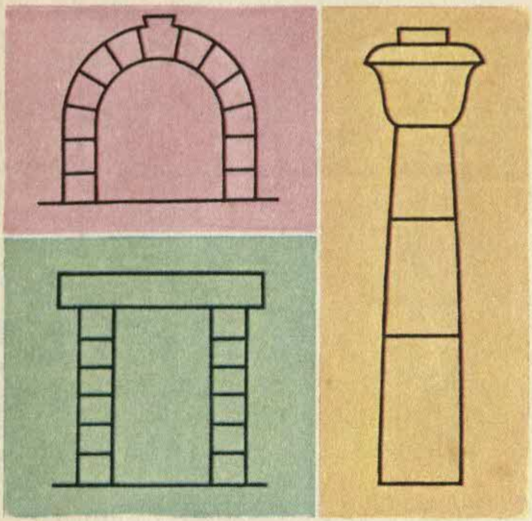


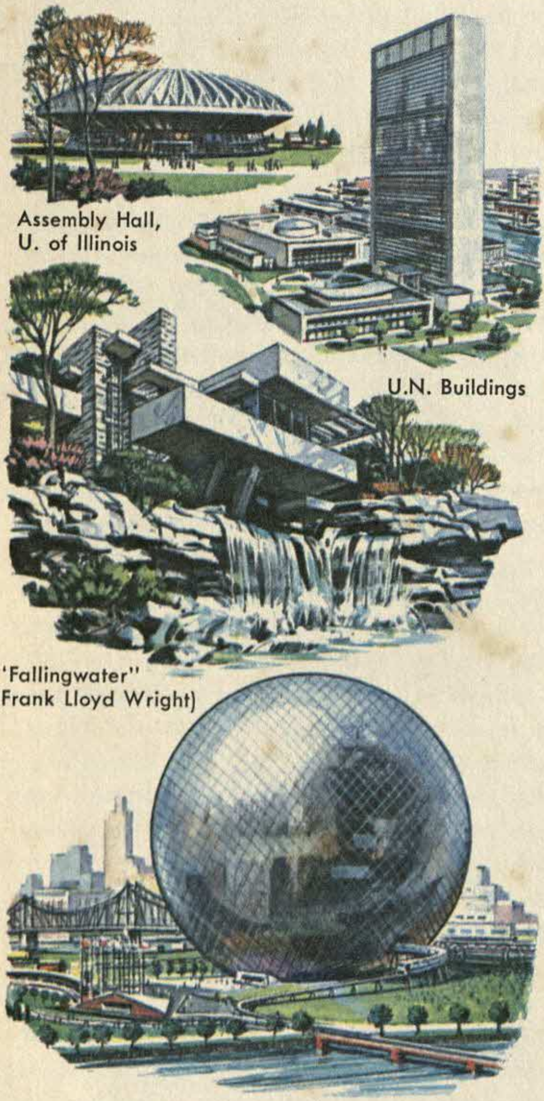
ARCHITECTURE An English writer once decided that he would tell the whole story of architecture in a book. He began planning his book, but he soon gave up. He decided that it would take at least 50 books and 20,000 pictures to tell the whole story.

A beautiful building is a work of art, just as a beautiful picture is, or a beautiful song. But an architect's problems are different from those of a painter or a songwriter. He must make what he builds useful as well as beautiful. A few monuments are built just to be looked at, but most buildings have other purposes, too.

"A building," someone once said, "is a space with walls around it and a roof on top." Walls around a space are rather easy to build. Long ago men learned that a solid wall could be made very strong if it was made thicker at the bottom than at the top. But windows and doorways in the walls are not so easy. The wall above an opening has to be held up. Roofs are even more of a problem. They must be strong enough so that they will not fall in. At the same time they must not be so heavy that they force the walls to collapse. Different ways of roofing a building have a great deal to do with the different styles of architecture that have been worked out.

People have used many different building materials over the centuries. For their large buildings the ancient Egyptians used tremendous blocks of stone. Slaves by the





Assembly Hall, U. of Illinois

U.N. Buildings

"Fallingwater" (Frank Lloyd Wright)

U.S. Pavilion, Expo 67

hundreds were used to pull the blocks to where they were needed. To hold up the wall above an opening, the Egyptians could use a long stone slab, or lintel.

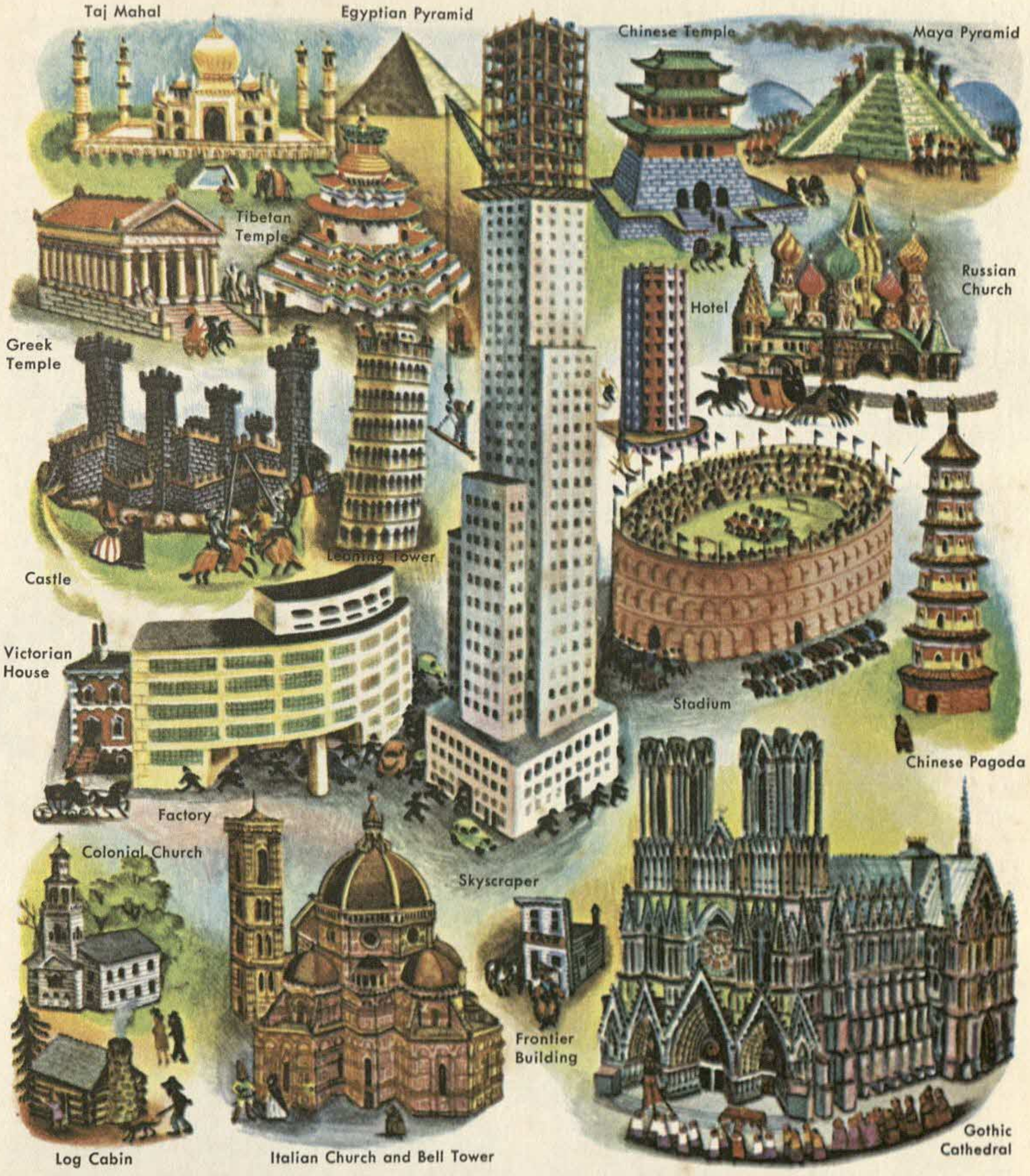
In the nearby land of the Tigris and Euphrates rivers the people could not get stone easily. They built their big buildings of baked bricks. One brick could not be used to reach across an opening as a slab of stone could be. But the early people of that land learned to build bricks into arches.

All through the centuries architects have had to think of their building materials in planning their buildings. In recent years many new materials have been developed. These new materials have given architects more choice and freedom in making their designs. The exciting new shapes of the pavilions built for Montreal's Expo 67 were possible chiefly because of the new materials. Expo 67 was spoken of as architecture's "leap into the future."

Other world's fairs, too, have had an influence on architecture. Chicago's Century of Progress in 1933–34 and New York's fair of 1939–40 helped bring about simpler lines and shapes in architecture and more interesting uses of color and texture. The building of great skyscrapers came only after the famous Eiffel Tower, designed and built for the Paris exposition of 1889, showed how a framework of steel can be made to support great weights.

An architect has many different kinds of work to do. He must be a designer, an engineer, an artist, a mathematician, and a salesman. He must know about the different building materials so that he can choose the best ones for his purpose. He must know about building codes and understand city planning. He must also be able to figure costs and to draw accurate working plans of his design. Learning to be a good architect today means years of studying.

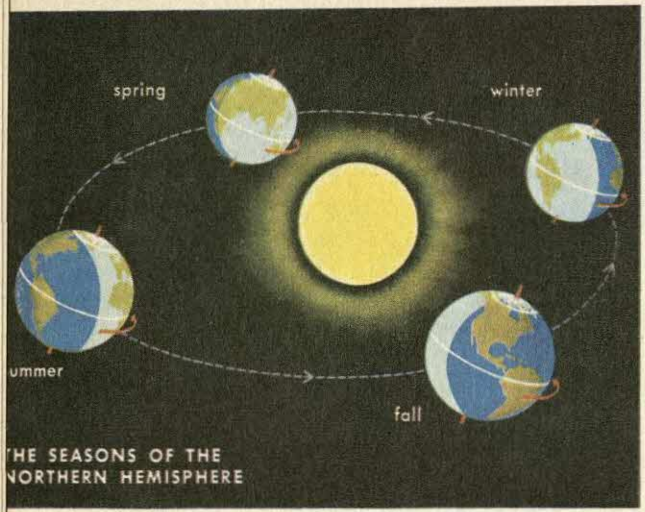
For a long, long time the great buildings were chiefly temples or churches or tombs. People were willing for centuries to live in houses that were not much more than huts



if they could have a beautiful temple to worship in. But nowadays many architects spend all their time planning beautiful homes. Moreover, many of the famous buildings of today are office buildings and other buildings where people work.

The pictures on these pages show buildings of many different types. These buildings were planned to serve a variety of purposes. Some are ancient; some are modern. Some are beautiful; others are not. A few have become world famous.

A nation tells a great deal about itself by the buildings it builds. It writes its history not only in words but also in stone and steel, concrete and brick. (See BRICK; BUILDING MATERIALS; CONCRETE; SKYSCRAPER; URBAN RENEWAL.)

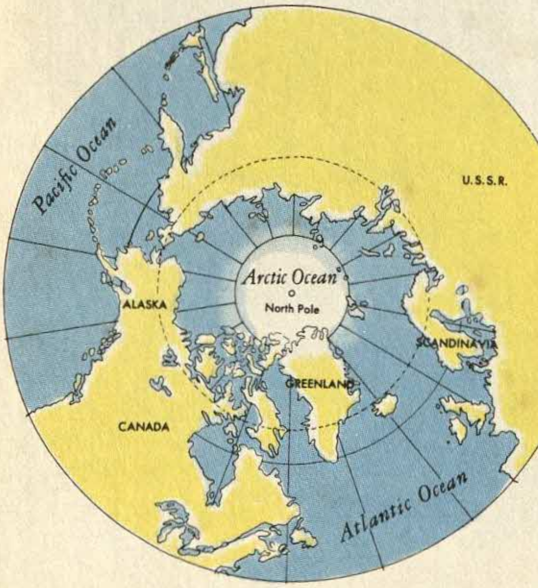


ARCTIC OCEAN The Arctic Ocean is at the "top" of the world. The North Pole is in the middle of it.

This ocean has a rim of land almost all the way around it. The northern shores of Asia and Europe and North America make up most of the rim. The big island of Greenland and other islands near it make up the rest.

Three of the ten longest rivers in the world empty into the Arctic Ocean. They are the Ob, the Lena, and the Yenisei.

Much of the Arctic Ocean is ice-covered year in and year out. Even in open water where boats can travel, floating ice is always a danger. There are never many boats in this cold sea. (See OCEANS.)

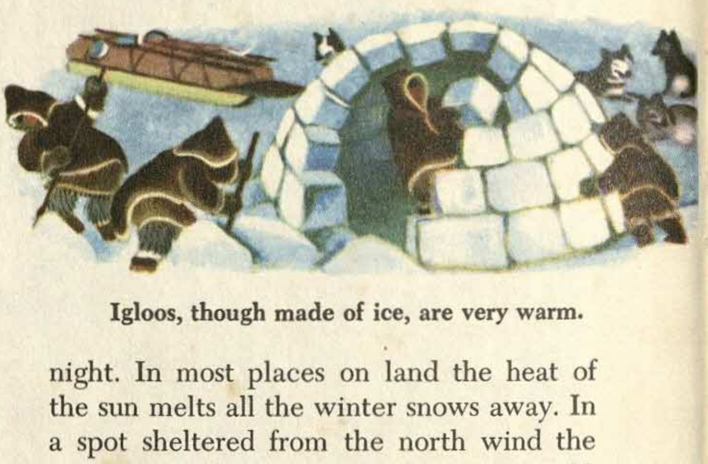


ARCTIC REGIONS "The Far North" is the name we often give to the Arctic Ocean and the lands that border it. One explorer calls the region "the friendly Arctic," but not many people would call it friendly.

The winters there are very cold. In places the temperature may go down to 90 degrees below zero.

Winter nights are long. In fact, for days or weeks or even months at a time in winter the sun does not rise at all. The closer one is to the North Pole, the longer the long night is. On winter days when the sun does shine it is low in the sky.

Summer days in the Arctic are long, just as winter nights are. For days or weeks or even months it is daylight all the time. The sun does not set. It shines even at midnight. In most places on land the heat of the sun melts all the winter snows away. In a spot sheltered from the north wind the temperature may at times go up to 100 degrees. But summers are not long enough to melt the ice deep in the ground.



Igloos, though made of ice, are very warm.

Great stretches of the Far North are empty. But the region is not without people. Among the natives are the Eskimos of North America and the Lapps of Europe. Most of the natives—there are not a great many—live by hunting and fishing. Some keep herds of reindeer. Besides the natives, there are settlements of people from other parts of the world. The Soviet Union, in fact, has built up several big cities in the "land of the midnight sun."

Some of the land of the Arctic is forested, but most of it is tundra. Tundra is al-

When the ice melts, Eskimos take to the water in their kayaks for hunting and fishing. Kayaks are made of animal skins stretched over a frame of wood or bone. They are very light.

Reindeer are the Arctic's most valuable animals. They are strong and can pull sledges. Reindeer also provide milk and meat. The hides are used for clothing.

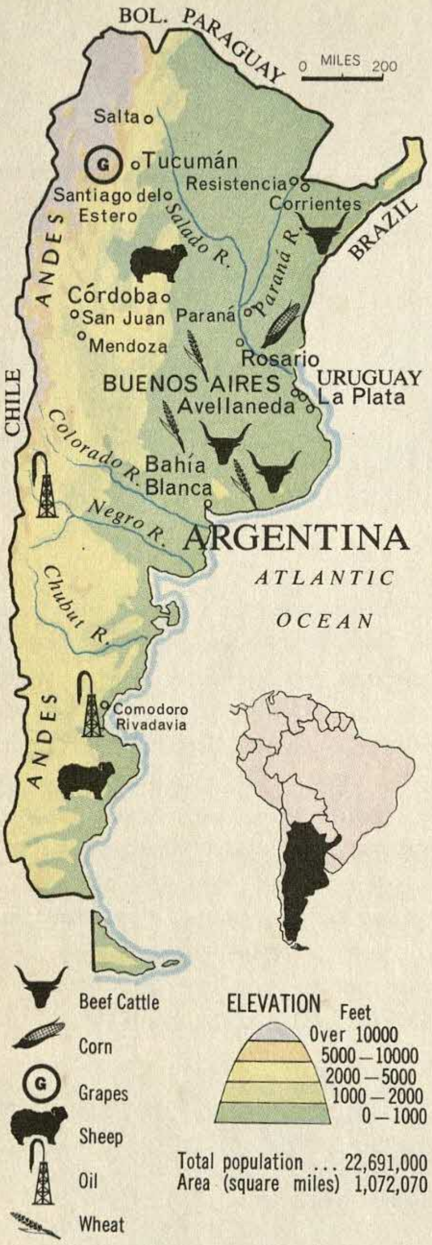
most level land covered with low plants such as lichens and mosses. There are even plants with gay flowers.

The polar bear is the arctic animal that people know best. A polar bear may live all its life without ever being off ice except to swim in the cold waters of the Arctic Ocean in its search for fish.

For a long time no one thought that the Far North was important. But now we know that it is. The Arctic, scientists have found out, has a great deal to do with our weather. Many weather stations have been set up there. The shortest air routes between parts of the Old World and parts of the New World cross the Arctic. A defense warning system, the DEW line, stretches from Greenland to Alaska. The Far North, moreover, is very rich in minerals—copper, nickel, gold, iron, tin, coal, petroleum, natural gas, and many others besides. The waters abound in fish and shrimp. The region has been called a "tomorrow land." Many more people will someday live in the vast Arctic than live there today. (See ESKIMOS; LAPLAND; NORTH POLE.)

Eskimos kill walruses for food. They also use the hides for clothing and the fat for fuel. The tusks have been carved into tools for centuries.

Musk-oxen form a tight circle to protect the females and the young when they are attacked. Their horns are very dangerous to wolves or hunters who threaten them. Musk-oxen are in danger of becoming extinct.



Meat packing is a major industry in Argentina.

ARGENTINA One country in South America faces the Atlantic Ocean and has its back to the Andes Mountains. Its "head" is near enough to the equator to be warm all the year, and its "feet" touch the cold antarctic sea. This country is Argentina.

Argentina is not nearly as large as its neighbor Brazil. But it is the second biggest country of South America. It stretches about 2,300 miles from north to south.

Of all the countries of South America, Argentina is most like the United States. It has much rich, level farmland. It has large areas suitable for ranches. Many different crops are grown in its many different climates. And more than half its people live in cities.

There are, however, some big differences between the United States and Argentina. One is that Argentina has few minerals. It has, for instance, almost no iron or coal. Another difference is that Argentina does not have nearly as many factories as there are in the United States.

The ancestors of most of the people of Argentina came from Italy or Spain. Spanish is the language spoken.

The most thickly settled part of the country is a vast prairie called the pampas. When the Spaniards who settled Argentina first saw this prairie, it was covered with grass higher than a man's head. The great stretches of tall grass were frightening. No one went into them except on horseback. Now the region is divided into farms, some small, others large. Very large ones

are called *estancias*. On one edge of the pampas is Argentina's capital and biggest city, Buenos Aires.

Wheat, corn, and flax are important crops raised in the pampas. Much wheat, corn, and flaxseed are shipped to other countries. Although the land there is divided into farms, a great deal of it has never been plowed. It is used as pasture for cattle and sheep. Argentina has long led the world as an exporter of raw meat. It exports a great deal of wool, too.

Between the pampas and the Andes the land is dry. Some areas in it are irrigated. Here there are orchards, vineyards, and fields of sugarcane.

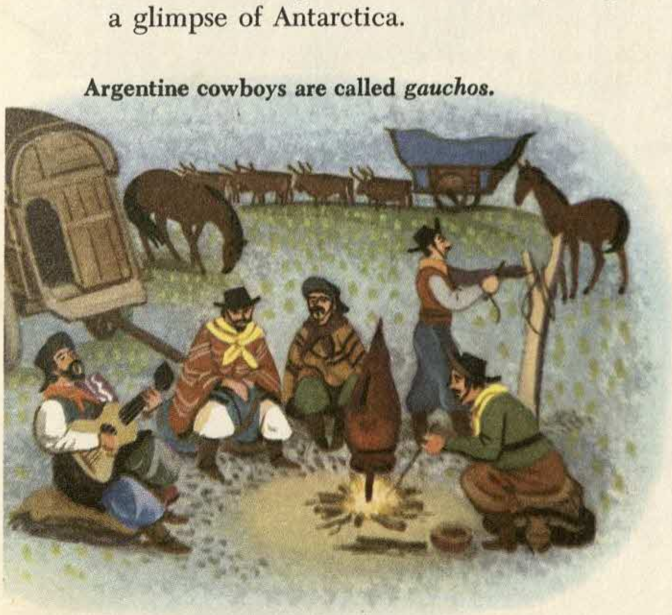
The northern part of Argentina lies in a great plain called the Gran Chaco. The chief products are cattle, cotton, and quebracho. Quebracho is a very hard wood. Its name means "ax-breaker."

The southern part of Argentina is in a barren, cold, and windy region called Patagonia. Here there is a little irrigated land, and some oil and iron. But most of the few people are sheepherders.

Part of the wild, lonely island of Tierra del Fuego belongs to Argentina. In it is the world's southernmost city, Ushuaia.

One of Argentina's many tourist attractions is a beautiful lake region in the southern Andes. And already tourists are stopping in southern Argentina on their way to get a glimpse of Antarctica.

Argentine cowboys are called *gauchos*.



ARISTOTLE (384–322 B.C.) Ancient Greece had many learned men. One of the most learned of them all was Aristotle. Two thousand years after he died, Europeans were still slow to believe anything which did not agree with his teachings. Even today people consider Aristotle one of the greatest thinkers who ever lived.

Aristotle's father was a doctor in the court of the king of Macedon, a country north of Greece. As a boy, Aristotle took a great interest in everything in the world around him. When he was only 17 he went to Athens to study with Plato, a famous Greek philosopher.

The word "philosophy" comes from the Greek words meaning "love" and "wisdom." To the Greeks, studying philosophy meant studying what we now call science. It meant also studying government and ideas of right and wrong.

Aristotle stayed in Athens for 20 years. Besides studying with Plato he did a great deal of writing. He and Plato were good friends, but they did not always agree.

A few years after Plato died, Philip, then the king of Macedon, asked Aristotle to come there to tutor his son. His son was Alexander, who became Alexander the Great. For seven years Aristotle was Alexander's tutor. He taught him all that he thought was best in the Greek way of living.

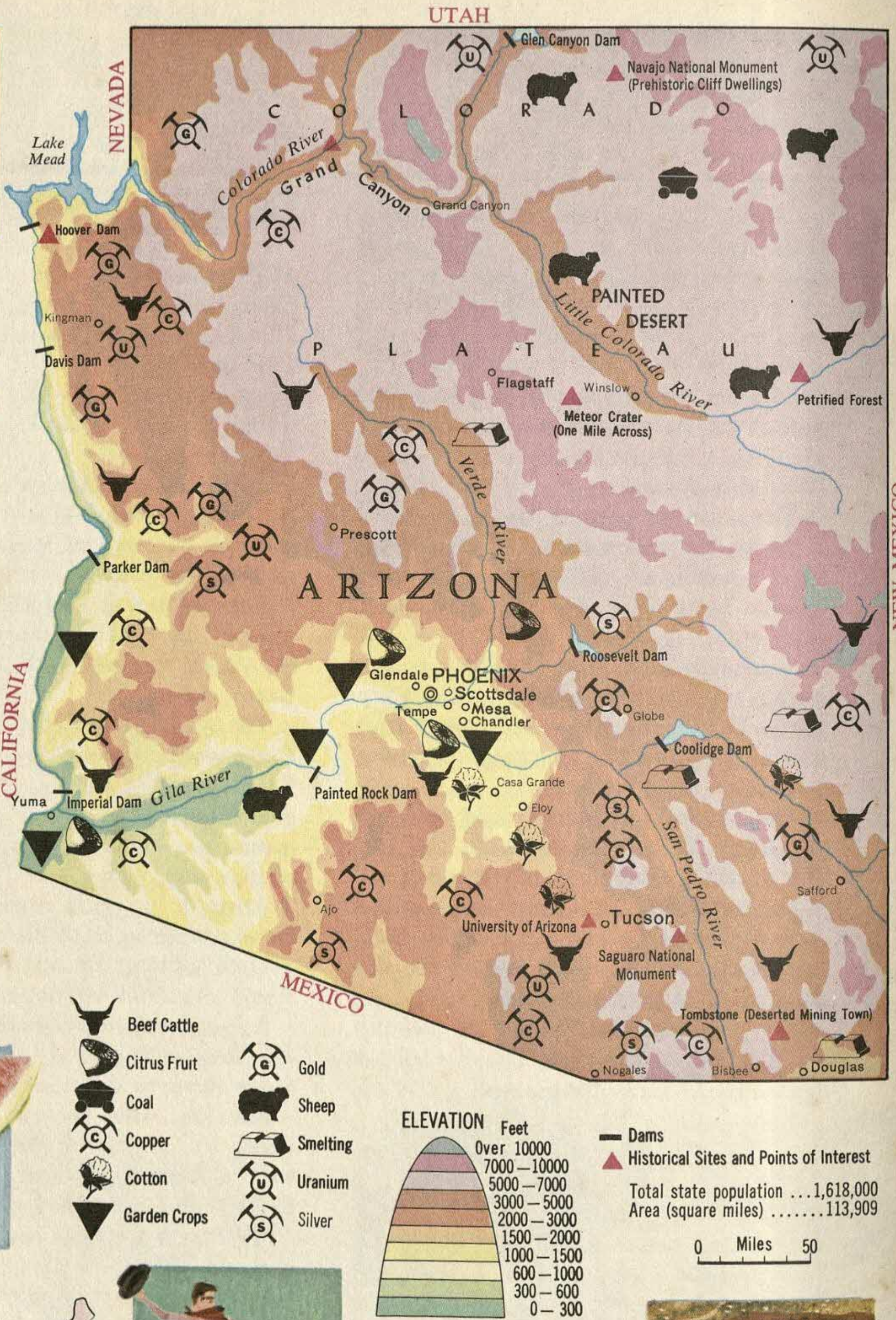
Aristotle then went back to Athens. He started a school of philosophy there. Today we know much more than Aristotle did about many things. We have gone far beyond him in science, for instance. But in all the centuries since Aristotle's time people have learned little about ways of thinking that Aristotle did not know.

State Bird: Cactus Wren

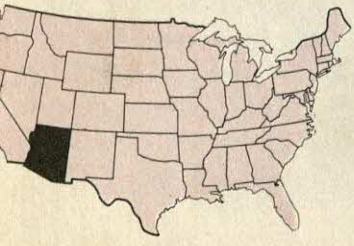
State Flower: Saguaro

Navaho Rug Loom

Grand Canyon



Total state population . . . 1,618,000
Area (square miles) 113,909



Gila Monster

Copper Mine

ARIZONA The amazing Grand Canyon is in the state of Arizona. It gives the state one of its nicknames—"Grand Canyon State." Another nickname is "Copper State." This name comes from the state's great copper mines. Arizona is the leading copper-mining state in the United States. Still another nickname is "Sunshine State." Arizona has more days of sunshine in a year than any other state. "Arizona" comes from an Indian word meaning "little springs."

The state flower and bird—the saguaro cactus and the cactus wren—are widespread in Arizona's hot desert areas. The state tree is the paloverde. "Arizona" is the state song. The state motto is *Ditat Deus,* Latin words meaning "God enriches."

Arizona is one of the mountain states of the Southwest. Its southern boundary is Mexico. At the northeast corner of Arizona is the Four Corners—the only place in the United States where four states meet. The three states that touch Arizona at this point are Utah, New Mexico, and Colorado.

Only five states are larger than Arizona, but 33 have more people. Arizona did not become a state until 1912. It was the 48th state to join the Union.

The first European to reach what is now Arizona came from Mexico in 1539. He was a Franciscan friar, Marcos de Niza. The next year the Spanish explorer Coronado came to the region looking for gold. Their visits had no important results. But in 1692 Father Kino began missionary work with the Indians and the work continued. Most of what is now Arizona became a part of the United States in 1848, the rest in 1853.

Pioneers found many difficulties in settling the Arizona territory. Mountains and high plateaus cover most of the region. They were too cool and rugged for farming. In the southwest there are broad plains. But here it was too hot and dry for farming. Besides, a fierce Indian tribe, the Apaches, fought hard to keep settlers away.

Copper was discovered in 1854. Settlers came in far greater numbers than before. By 1886 the Apaches had given up their war against newcomers.

The scarcity of water was still a great handicap to farming. Irrigation, of course, was the answer. Since 1900, big dams have been built across several rivers. The dams have helped form large lakes. From these lakes water now comes to more than a million acres of farmland on the plains. Cotton, lettuce, melons, oranges, grapefruit, and dates are among the crops raised in the irrigated fields.

In the higher land of Arizona there are big ranches. Cattle and sheep find good grass for pasture there.

Arizona's copper mines produce hundreds of thousands of tons of copper a year. The state also has important gold, silver, and uranium mines.

In no other state are there as many Indians as there are in Arizona. Navahos, Hopis, and Apaches make up a large part of the Indian population. The Navahos raise cattle and sheep. The Hopis are farmers and sheep raisers. The Apaches raise cattle and sheep and also do some lumbering.

About three-fourths of Arizona's people live in towns and cities. The two largest cities are Phoenix, the capital, and Tucson. Phoenix has more than 500,000 people, Tucson about 240,000. These two cities are vacation and health centers.

Every year brings thousands of visitors to Arizona. Winter is the chief tourist season. People from places where winter means cold weather and gray skies enjoy the warmth and bright sunshine of Arizona.

Arizona has many interesting sights besides the Grand Canyon for visitors to see. These are a few of them: the Petrified Forest, the Painted Desert, the enormous Hoover Dam, the mile-wide Meteor Crater, forests of giant cactus, old Spanish missions, the ghost gold-mining town of Tombstone, and "apartment houses" built centuries ago by the cliff dwellers. It is no wonder visitors have been a big help in making Arizona a fast-growing and prosperous state.

ARKANSAS (AR kan saw) As the little map on the next page shows, Arkansas is a southern state. Unlike most states of the South, it has no coast. The broad Mississippi River forms its eastern boundary.

This state was once nicknamed the "Bear State" because many hunters used to go there to hunt and trap bears. But in 1953 the state legislature decided that a better nickname would be "Land of Opportunity." Another nickname is "Wonder State."

Arkansas took its real name from that of a tribe of Indians. The name means "downstream people." As you see, Arkansas's state bird is the mockingbird and its state flower is the apple blossom. Its state tree is the shortleaf pine. "The Arkansas Traveler" is the state song. *Regnat populus*, the state motto, means "The people rule."

Arkansas is a "middle" state in both size and population. Twenty-six states are larger. Thirty have more people.

About one-half of the workers of Arkansas are farmers. Some of their farms, however, are quite different from others.

On the lowlands near the Mississippi there are large cotton plantations. Arkansas is far enough south to be one of the cotton states. The rich soil along the river is good for cotton. But not all the farmers near the river raise cotton. Some raise rice. Rice grows in fields flooded with water. The rice farmers irrigate their land. Corn and soybeans have also become important crops on part of the lowlands.

Arkansas has another rich farming section in the northwest. The land there is high. The weather is not warm enough for cotton. The farmers raise fruit, hay, chickens, beef cattle, dairy cows, and hogs.

Just as about one-half of the workers of Arkansas are farmers, about one-half of the land of Arkansas is farmed. Most of the rest of the state is still covered with forest. Lumberjacks work in the forests cutting down timber. In many towns and villages there are sawmills. There are factories, too, for making the lumber into barrels, furniture, and floorboards. In recent years thousands of oil and gas wells have been drilled in the state. Many of them are in the southern part near the town of El Dorado. In this section there are refineries for making petroleum into gasoline, fuel oil, and other products.

An important aluminum ore called bauxite is mined near the town of Bauxite. Arkansas produces a very large part of the bauxite mined in the United States.

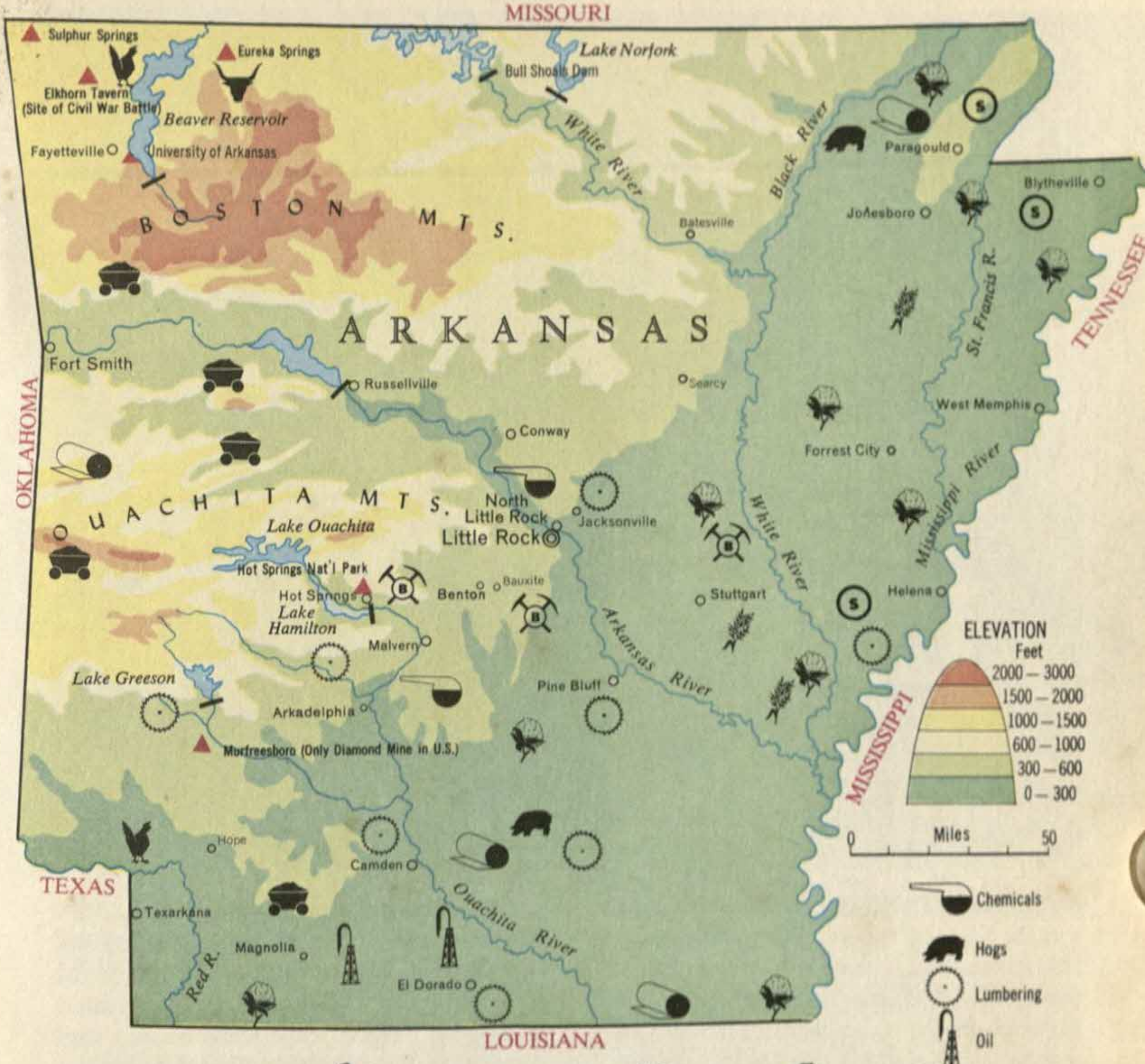
Many people from other states like to spend vacations in Arkansas. In the highland regions the springtime is long and pleasant. For much of the year there is good fishing in the streams. The forests offer good hunting. Raccoons, opossum, and deer are plentiful. So are game birds. Arkansas has many springs, and health resorts have grown up around some of them. Hot Springs National Park is the most famous of these health resorts.

Near Murfreesboro visitors can, for a dollar or so, go diamond hunting. There was once a diamond mine there. Diamond Cave, which stretches for more than 20 miles in the Boston Mountains region of the Ozarks, attracts many visitors. So does Mammoth Spring, from which about 200 million gallons of water a day pour.

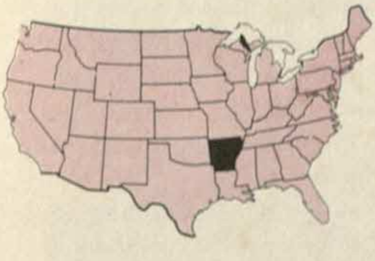
More than 400 years ago the Spanish explorer De Soto visited what is now Arkansas. In 1686 another explorer, Henry de Tonti, started the first white settlement there. The region was bought by the United States from France in 1803 as a part of the Louisiana Purchase.

After 1803 many settlers came to Arkansas from Kentucky and Tennessee. Soon cotton planters came from the Deep South. They brought their slaves with them. The population grew. Arkansas became a state in 1836. In the Civil War it fought with the South.

Since so many of its people are farmers, it is not surprising that Arkansas has no very large cities. Its largest is the capital, Little Rock. The population of Little Rock is about 136,000.

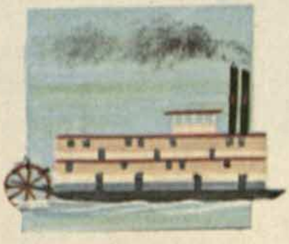


Total state population . . . 1,955,000
Area (square miles) 53,104



State Bird: Mockingbird

State Flower: Apple Blossom



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Spanish Armada

ARMADA, SPANISH In 1588 Philip II was the ruler of Spain, which was then one of the strongest countries in the world. At that time Elizabeth I was the queen of England. Philip was a devout Catholic and wished to make England a Catholic nation, as it had once been. He had plotted to bring this about but his plots had failed. Now he decided to send a great fleet, or armada, to attack England.

The Spanish fleet was made up of about 130 vessels, many of them huge sailing ships of the kind called galleons. With their painted sails, the galleons were a magnificent sight. Philip was sure that his fleet could win any battle.

But from the first the fleet had misfortune. It had not gone far from Spain when it met a terrible storm. There was so much damage that the ships went back for repairs.

Before the Armada reached England, the English were warned that it was on its way. Beacon fires on hilltops sent the word far and wide. The English ships readied themselves. These ships were smaller and faster than the Spanish galleons. When the fleets met, there were four days of fighting, but the Spanish continued full sail ahead. Then came a fierce daylong battle. The English won, and the battered Spanish fleet started back to Spain.

But there was still more misfortune in store for the Armada. As it went home by a long route to the north of Scotland, it ran into one storm after another. Many ships went down or crashed against the shore. Only about 50 of the great fleet ever reached Spain. Spain never got back her sea power, and England became master of the seas. (See ELIZABETH I.)

ARMADILLO All mammals have hair. Armadillos are mammals. But where is the hair of the armadillo in the picture?

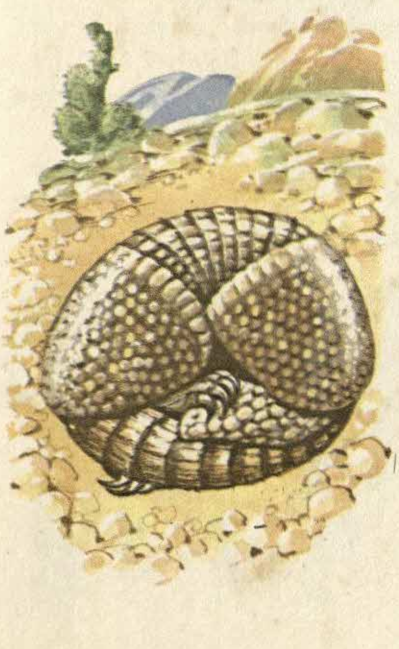
Through the ages this strange mammal has lost most of its hair. What is left is hidden by an armor of small bony plates. The armor is a good protection against thorns and all but the biggest of the armadillo's enemies. As you see, the armadillo can roll itself up so that its armor covers it.

During the daytime an armadillo usually stays in its burrow. It does most of its food hunting at night. It eats fruit, ants, worms, and other soft foods.

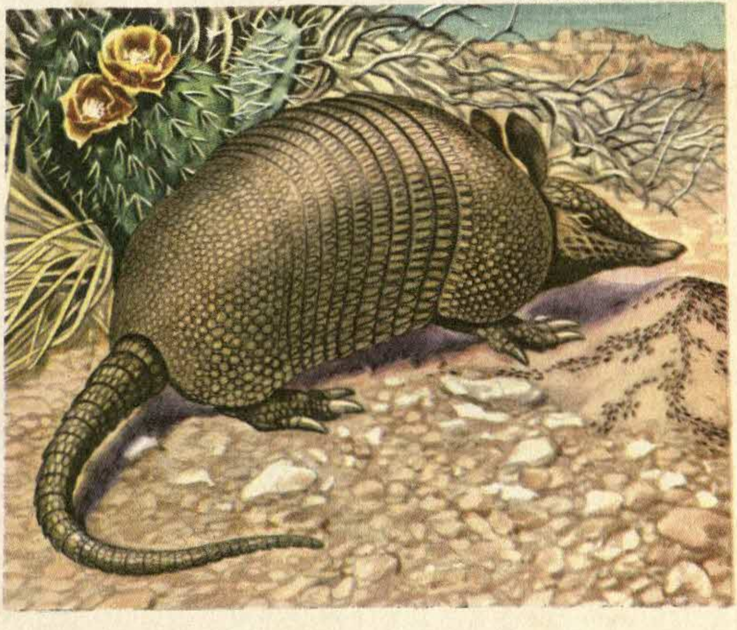
Nine-banded armadillos are born four at a time. The babies are so much alike that it is almost impossible to tell them apart. They are identical quadruplets.

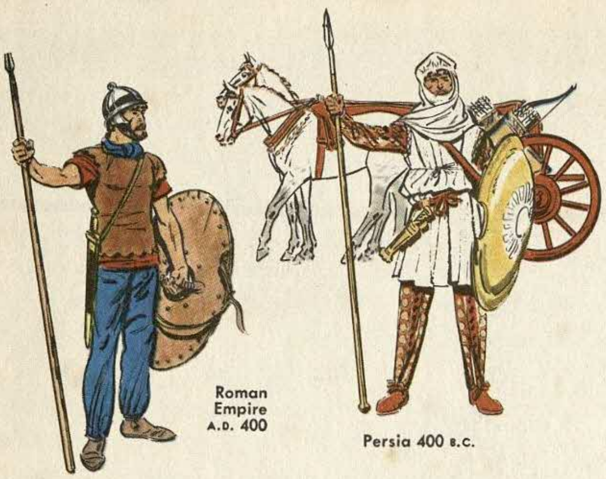
There are many other kinds of armadillos. They are all American animals. South America is the home of most of them. The nine-banded is the only one found in the United States. The largest of the group is the giant armadillo of the South American rain forests. It may weigh 100 pounds. None of the armadillos of today are as big as their glyptodon relatives of long ago. Some glyptodons were as big as rhinoceroses. (See MAMMALS; MAMMALS OF YESTERDAY; TWINS.)

When frightened, an armadillo rolls itself into a tight armored ball.



Nine-banded Armadillo





ARMOR Men may have got the idea of armor from animals. Many animals carry their own armor around with them. Turtles and armadillos are some that do.

Among the first pieces of armor men used were shields. The earliest shields were made of tough wood or hides. But as soon as men learned to work metal they made shields of bronze or iron.

In time, ancient warriors were not satisfied with just shields. They developed armor that covered almost their whole bodies. On their heads they wore helmets. On the upper part of their bodies they wore cuirasses (kwe RAS es). On their legs they wore greaves.

Armor reached its peak during the Middle Ages. Then, at least in Europe, knights in full armor were a common sight.

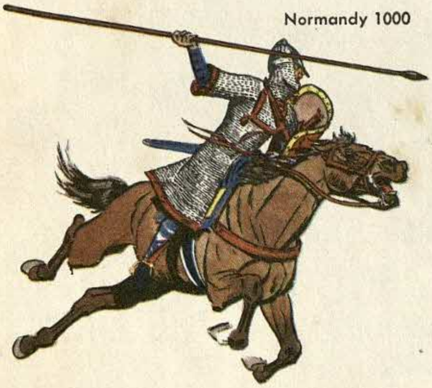
During the wars called the Crusades, which were fought in the Middle Ages, chain mail was much used for armor. Chain mail was made of tiny metal rings linked together.

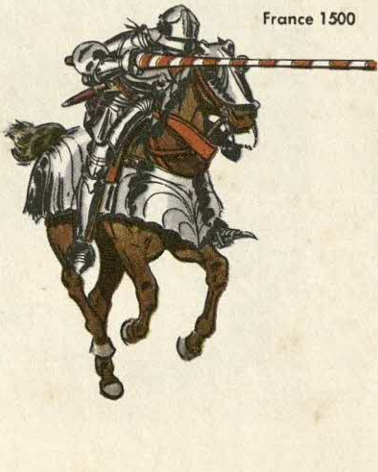
In the 1300's plate armor gradually took the place of chain mail. Plates of metal were joined to make whole suits. The finest helmets of this time had visors that could be lowered to protect the knight's face. The visors had small openings in them so that the knight could see and could get air. Even the horses of the knights wore armor.

A knight was so well covered by his armor that no one could see who he was. Therefore knights often had emblems painted on their armor. Sometimes a suit of armor had beautiful designs carved in it. A knight in shining armor mounted on a powerful horse and with plumes flying from his helmet looked very splendid.

For many centuries soldiers had to protect themselves only from such weapons as swords and spears and arrows. But after gunpowder was invented, ways of fighting changed. Even 400 years ago guns could shoot through plate armor of the kind the knights had been wearing. The armor had to be much thicker to be of any use. Then a suit of armor weighed so much that an armored rider could no longer mount his horse without help. He had to be hoisted up. No wonder heavy armor gradually disappeared from the battlefield.

Some armor, however, is still in use. Soldiers still wear steel helmets in battle. Armored, or "bulletproof," vests are often worn by soldiers and policemen.


Normandy 1000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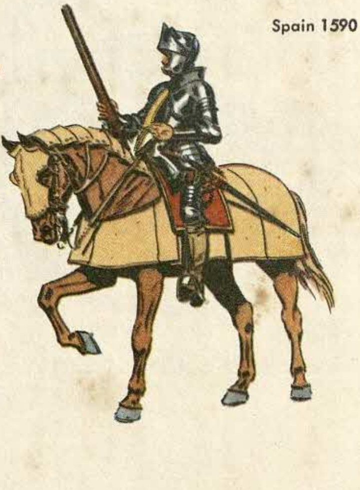
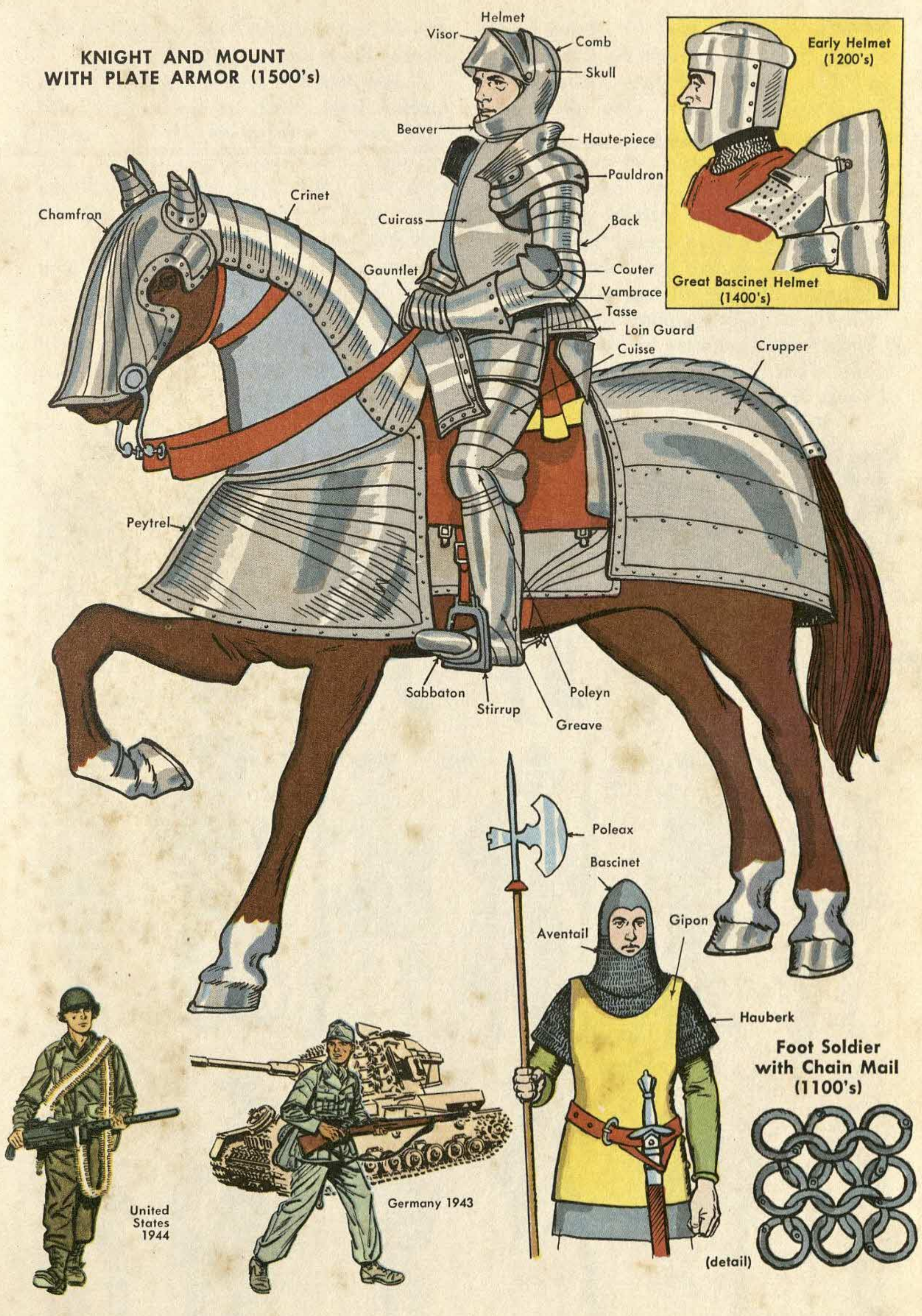

Spain 1590



KNIGHT AND MOUNT WITH PLATE ARMOR (1500's)

Early Helmet (1200's)

Great Bascinet Helmet (1400's)

Foot Soldier with Chain Mail (1100's)

(detail)

United States 1944

Germany 1943

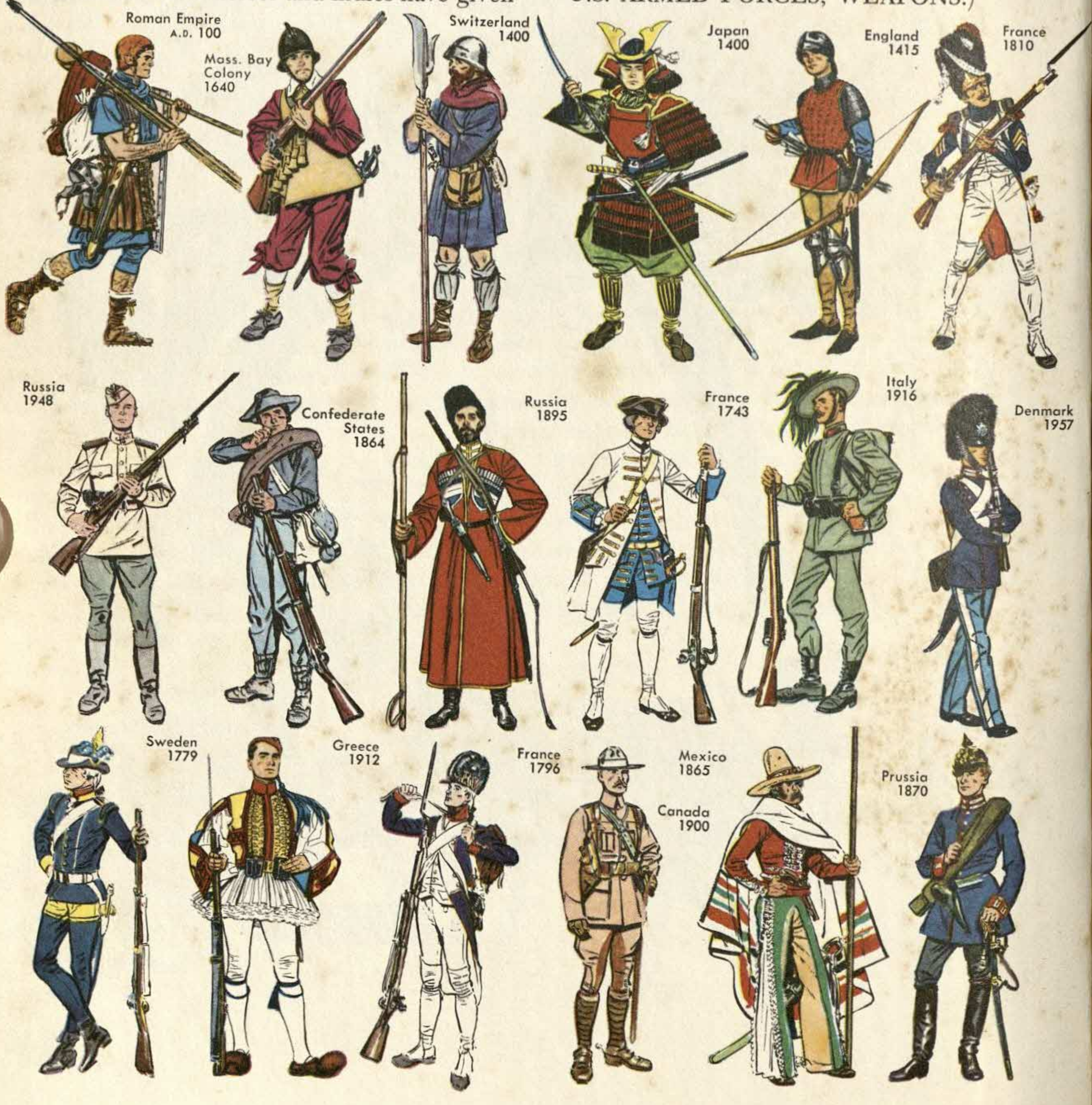
ARMY An army is a body of fighting men trained and equipped to fight on land. There have been armies ever since there have been nations. The pictures show some uniformed soldiers of the past.

In the earliest armies all the soldiers were foot soldiers. They used swords, spears, and bows and arrows. But even 4,000 years ago some armies had horses and war chariots. In time almost every army had its cavalry—soldiers on horseback.

The invention of gunpowder made guns possible. Soon there were big guns that had to stay in one place or be pulled by horses or mules. Now horses and mules have given way to tanks, trucks, helicopters, and airplanes. There are new weapons, too.

Helicopters and airplanes carry soldiers quickly from place to place. They also work closely with ground forces in actual fighting. Guns of nearby naval vessels may help, too. Today land, air, and sea forces often work closely together. Among the new weapons are rockets and missiles.

Some armies of modern times have been huge. During World War II the U.S. Army alone had several million soldiers. It seems strange that in 1066 William the Conqueror vanquished England with only 5,000. (See U.S. ARMED FORCES; WEAPONS.)



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